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A MONOGRAPHIC STUDY
OF THE
GENUS PRITCHARDIA

By ODOARDO BECCARI AND JOSEPH F. ROCK

Memoirs of the Bernice Pauahi Bishop Museum
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(WITH PLATES I-XXIV)

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A MONOGRAPHIC STUDY OF THE GENUS PRITCHARDIA.

BY ODOARDO BECCARI AND JOSEPH F. ROCK.

INTRODUCTION.

By JOSEPH F. ROCK.

THE present study of the genus *Pritchardia* is mainly the work of Dr. O. Beccari of Florence, Italy, and forms part of a monograph on the tribe *Coripheae* to which the genus *Pritchardia* belongs. The manuscript was prepared in Latin for publication in the Annals of the Calcutta Botanical Garden, but Dr. Beccari has consented to have that part of his monograph dealing with the genus *Pritchardia* published in English in Honolulu. Of the thirty-three species described in this paper twenty-one including five varieties were discovered by me, and several old species were rediscovered and their status cleared. My recent explorations on the islands of Kauai, Molokai, and Hawaii resulted in the discovery of several new species and one new variety. Specimens of these and of other new species were forwarded to Dr. Beccari, but I am responsible for the description of the following: *Pr. kaalae*, *Pr. Forbesiana*, *Pr. Hardyi*, *Pr. Munroi*, *Pr. montis-kea*, *Pr. viscosa*, *Pr. Lowreyana* var. *turbinata*, *Pr. Martiodes*, and *Pr. Kahanae*. Plates illustrating this monograph are from photographs taken by me; the drawing of the flowers was made by Dr. Beccari. It is hoped that the present paper will be a stimulus to further exploration by future botanical workers, for it is probable that the Hawaiian Islands harbor a number of other new species of *Pritchardia*. Special attention should be given to the western part of Oahu, the windward side of Molokai, especially the valleys of Waikolu, Pelekunu, and Wailau, and to the windward slope of Haleakala on Maui. On the island of Hawaii, Waipio, Waimanu, and other valleys of Kohala have not been searched for palms, and the island of Kauai may reward the assiduous explorer with additional new species. I desire to express my sincere thanks to Mr. W. R. Castle, Mr. C. M. Cooke, Jr., Mrs. J. R. Galt, Mr. F. J. Lowrey, the Outdoor Circle, Miss Annie S. Parke, Mrs. F. M. Swanzy, Mr. E. D. Tenney, Mr. John Waterhouse, and the Trustees of the Bishop Museum for generous contributions to the expenses for field study and publication. Thanks are also due to Dr. Beccari for his kindness in permitting publication of his manuscript prior to its appearance in the Annals of the Calcutta Botanical Garden.¹

¹ The scientific world has suffered a severe loss in the death of Dr. Beccari which occurred at Florence, Italy, Oct. 25, 1920.

PART I.—DISTRIBUTION AND CHARACTERISTICS.

GENERAL DISCUSSION.

By ODOARDO BECCARI.

DISTRIBUTION.

THIS fine group of palms, of which up to a quite recent date but few representatives were known, now numbers thirty-one well characterized species and some very distinct varieties.

This great increase in the number of known species of *Pritchardia*, is chiefly due to the recent discoveries of Professor Joseph F. Rock of the College of Hawaii, who has carefully explored the islands composing the Hawaiian group, in search of their indigenous palms and has been extraordinarily successful in discovering a large number of new and fine species, of each of which he has taken special care both to collect and prepare complete specimens in flower and in fruit.

This material, generously placed at my disposal by Professor Rock, forms the principal basis of the present monograph.

The *Pritchardias* constitute one of the most characteristic genera of palms belonging to the Polynesian Flora, which, with some of its scattered members, occupies a very extensive geographical area in the islands of the Pacific, but has attained its greatest development in the Hawaiian archipelago. With the exception of *Pritchardia*, no other genus of palms occurs in Hawaii, although the western Polynesian islands contain a good number of others.

The *Pritchardias* first described were *Pr. Martii* and *Pr. Gaudichaudii*, both from Hawaii, and were considered as belonging to the genus *Livistona*. The generic name *Pritchardia* was afterwards established for a palm growing in the Fiji Islands, *Pr. pacifica*, and it was later discovered that *Livistona Martii* and *L. Gaudichaudii* were referable to the genus *Pritchardia* of which *Pr. pacifica* is the type. Another *Pritchardia*, *Pr. Thurstonii*, was also found in Fiji. Perhaps some other palms akin to these are living in the archipelagos nearest to Fiji. Two species have been found in the distant Dangerous Archipelago (*Pr. Vuylstekeana* and *Pr. pericularum*), but at least twenty-three well distinguished species, that is 74 per cent of all the genus are endemic in the Hawaiian group. A very characteristic *Pritchardia*, *Pr. Wrightii*, has found its way into the new world. This is one of the most extraordinary facts known of geographical distribution of palms, comparable to the presence in America of a *Raphia*, but even more to that of the characteristic *Coccinea* in South Africa, the *Jubacopsis Caffra*.

Pritchardia Wrightii is a palm which grows only in Cuba and near the southern coast of the little Isla de Pinos. This palm, although distinguished among

all its congeners as a species, is so similar to them in leaf-structure, flowers, and fruits, that it is impossible not to admit that this species had a common origin with them. It is also a singular fact, unique to my knowledge among the palms, that the three segments of the corolla detach themselves from the corolla tube at the moment of flowering, leaving the stamens uncovered, in *Pr. Wrightii* in exactly the same manner as in all its congeners.

In what manner the fruits of the progenitrix of *Pr. Wrightii* were enabled to cross the wide spaces of ocean, interposed between the nearest Polynesian Islands inhabited by the *Pritchardia* and the American continent, is a mystery. And this mystery is greatly increased by the fact that these fruits must have surmounted the mountain chain which separates the Pacific from the Atlantic, unless we assume that in some more or less remote geological epoch, the configuration of the western coast of the American continent, was very different from what it is at present, and that the vast expanse of the Pacific was broken by lands now submerged, thereby lessening the immense distances now interposed between the most eastern islands of Asia and the New World.

I am willing to admit with Guppy¹ that the dispersal of the fruits of many plants may have been assisted locally by pigeons, and that through their agency, the geographical area of the *Pr. pacifica* may have been amplified, and even that by such means forms related to that species may have been produced. In the special case of *Pr. Wrightii* one may perhaps suggest the hypothesis, already put forth by me,² of the transfer of the fruits of certain plants by means of the violent volcanic phenomena which must surely have occurred during the elevation of the Andean ranges. Nor is the probability to be excluded, that at such a time a communication by water may have been established between the two oceans, and that the fruits of a *Pritchardia* of Polynesia may have been carried to, and finally deposited on, an island in the Caribbean Sea. Guppy however supposed that even the fruits of the large-fruited species of the Hawaiian Islands may have been transported by ocean currents, as he notes that those of *Pr. Gaudichaudii* are of such a nature as to allow them to float for at least five weeks. But that this and other Hawaiian species with similar large fruits can have originated from small fruits such as those of the Fijian *Pr. pacifica* and *Pr. Thurstonii*, I find it hard to believe. It seems to me more likely that the opposite is the truth, that is, that the Fijian species may have been derived from those of Hawaii, and also that the two species of the Dangerous Archipelago may have been derived from the same source.

There is not a shadow of doubt that the *Pritchardias* are generically closely related to the Asiatic *Corypheae*, *Livistona* and *Licuala*, and especially to the *Pritchardiopsis* of New Caledonia; but on the other hand the genera *Washingtonia*, *Brahea*, *Erythea*, and *Copernicia*, all proper to the western part of North America, exhibit an equal degree of affinity to the *Pritchardias*. If one considers the great

¹ Guppy, H. B., *Observations of a Naturalist in the Pacific*, vol. II, p. 326, 1906.

² *Malesia*, vol. III, p. 303.

scarcity, indeed the almost total absence of *Corypheae*, in all the Polynesian archipelagos, with the exception of *Pritchardia* and *Pritchardiopsis*, we may regard the latter as surviving members of a type of palms, once widely diffused, but now almost wholly swallowed up with the hypothetical lands of the Pacific.

The great precinctiveness of the species of *Pritchardia* in Hawaii proves that their dispersal, even locally, is difficult. No species of *Pritchardia* is found represented on more than one island. It happens sometimes, however, that ripe fruits of some species of *Pritchardia*, *Gaudichaudii* for instance, falling on the ground take root around the mother plant and form small stands when they grow up. *Pr. Beccariana* alone according to Professor Rock is to be met with as numerous scattered individuals in the rain forests of Glenwood on Hawaii. But more often the trees of *Pritchardia* grow isolated, and at heights varying from 1,000 to 1,200 meters on inaccessible cliffs, exposed to terrific winds. According to Professor Rock, certain species of *Pritchardia* on Hawaii are found in the dark forests, growing among stately trees, while on the lee side of that island, they come down to 600 meters and even lower, near the sea level. On Oahu the palms are confined to the summits of ridges and to the steep slopes of valleys. The more or less globose fruits of some isolated trees may fall on the ground, roll down to the bottom of the ridge or slope where they grow, and be carried by heavy rains into the valleys below, or be caught in some crevice of the rocks; but how those palms which wave the crown of their leaves against the sky on the crests of the most inaccessible ridges, have managed to establish themselves at such a height, and what can have carried their seeds thither is as yet a puzzle. The fruits of some species, such as *Pr. Hillebrandi* and *Pr. affinis*, have a moderately fleshy mesocarp of pleasant taste, which recalls that of a date. They are small enough to be swallowed for the sake of the pulp by pigeons, such as *Myristicivora* and *Carpophaga*; these birds indeed are among the most effective agents of dispersal of the fruits of many plants in Papuasias and Polynesias. They are however unknown in the Hawaiian Islands. On the other hand it must be acknowledged that the palms which produce the above mentioned kind of fruits, especially *Pritchardia affinis* and its varieties, are the more diffused species and are represented by allied forms on islands even at a distance from the central group, such as *Pr. remota* from Nihoa or Bird Island, to say nothing of *Pritchardia lanaiensis*. Perhaps also the two species of the Dangerous Archipelago are related to *Pr. affinis*.

In consequence of these considerations it is allowable to suppose that at some time, when greater terrestrial connections existed between the remoter islands of eastern Polynesia and those of Papuasias and occidental Polynesias, the Columbidae may have been the agents which contributed even more than ocean currents to stock with palms the islands of the Hawaiian group; but as I have pointed out⁸ no species of *Ficus* form part of the indigenous Hawaiian flora, while the fruits of these trees are among the best liked by that family of birds. If the Columbidae

⁸ Malesia, vol. III, p. 316.

had been one of the means by which some elements of the western Polynesian flora were introduced into the Hawaiian Islands, one does not understand why no species of *Ficus* has found its way there. And then, by what means were the large fruits of *Pr. Beccariana*, *Pr. arecina*, *Pr. Rockiana*, *Pr. Gaudichaudii*, *Pr. Lowreyana*, *Pr. macrocarpa*, enabled to reach high mountains, even their most inaccessible summits? One really cannot conceive what agency can have transported thither such relatively voluminous fruits. It is a fact absolutely opposed to what happens on the high Malayan mountains, where only plants having very small seeds, easily transported by winds, or sought for by birds or other animals, have succeeded in establishing themselves. At times the natives plant some *Pritchardias* near their dwellings, but there is certainly no reason to think that they planted palms in places inaccessible to themselves. At present it does not seem that any terrestrial animals exist that feed on the fruits of the *Pritchardias*, and contribute, even indirectly, to their dissemination by carrying their fruits into nests or hiding places, such as the crevices of rocks, as do squirrels or rats. Yet it is possible that in the past this work was performed by a species of rat (*Rattus hawaiiensis*), now generally believed extinct, but which Professor Rock informs me, has been found on an islet off the coast of Oahu.⁴ The rats now met with in the Hawaiian group have only been introduced there since the days of ocean shipping. Another animal of recent introduction into this group is the mongoose (*Herpestes*), which seems, however, to contribute more to the destruction of the *Pritchardias* than to their preservation and dissemination. At least this appears to be the case. The immature fruits of *Pr. Martii*, at least, are destroyed by the mongoose to a degree that makes it difficult to procure ripe fruits for the purpose of propagation.

To give a probable account of the geographical distribution of the *Pritchardias*, it may be necessary to have recourse to the hypothesis that during a former epoch the fruits of certain species or genera of plants which possessed great facilities for reproduction were transported from one island to another by means of ocean currents or by birds—a hypothesis which involves the assumption that during this hypothetical epoch the enormous distances which now exist between the island groups in the Pacific were bridged by means of islands which have now vanished.

We cannot refuse to admit that the present geological structure and configuration of the islands forming the Hawaiian archipelago are very different from those which existed before great seismic cataclysms raised the present mountains and broke the original land into fragments. We can picture to ourselves a period of geological calm in which the area now occupied by the Hawaiian Islands was a flat plain like the Aru Islands, without volcanic cones or precipitous mountains.

This period corresponded probably to an epoch in which the various fragments of land scattered in the Pacific, the Hawaiian group being among them, were

⁴ Stone, Witmer, The Hawaiian rat. Stokes, J. F. G., Notes on the Hawaiian rat: Bishop Museum Occasional Papers, vol. III, No. 4, 1917.

less isolated than now. During that epoch the fruits of the primitive *Pritchardias*, and also of other tropical plants, may have been deposited here and there on the islands of the group, by birds, ocean currents or even winds, thus creating a special vegetation; but when the great seismic and eruptive period arrived, the vegetation which covered the plains may have been carried, in part at least, on the mountains which were rising, and to a certain extent may have been preserved upon them. With this hypothesis a part of the vegetation now existing on the Hawaiian mountains could be considered as a surviving element of that which covered their plains before the advent of the great cataclysms which completely changed the orographical structure of the region.

FERTILIZATION.

The flowers of the *Pritchardias* open in an unusual manner. Their corollas apparently perform one function only, that of sheltering the sexual organs. They serve no vexillary purpose; that is to say, of attracting insects or birds. The flowers are small, and only by their *ensemble* may attract those creatures who know their meaning. The three segments of the corolla become detached from the tubular portion projecting from the calyx, and drop at anthesis, that is when the anthers are ready to scatter their pollen grains.⁵ This mode of flowering is perfectly analogous to that of certain *Ampelideae* and *Araliaceae*. The petals having fallen, the anthers, borne on short filaments, radiate from the mouth of the tube of the corolla and around the style, which projects more or less from the stamens. This contrivance seems to be very favorable to the impollination of the ovaries by bees or other flower-haunting insects, as in *Vitis* and *Hedera*. Perhaps also as in the flowers of these plants some special odor, imperceptible to our senses, serves to attract insects from a distance.

I have no positive observations in regard to any saccharine secretion in the flowers of the *Pritchardias*, as it is not easy to verify this occurrence from dry herbarium specimens. To tell the truth, though the tube of the corolla of the *Pritchardias* is of such a conformation that it might be taken for a recipient fitted for collecting nectar, and even its side walls, which are somewhat thick, would suggest a nectarifluous structure, yet in all the flowers examined I have not met with any trace of a saccharine secretion.

The pollen grains of *Pr. affinis*, which I have examined with the microscope, are, in the dry state, ellipsoidal in shape with a deep longitudinal fold, but when swelled by immersion in water, assume an ovoid-ellipsoidal or even subglobose shape; their surface is perfectly smooth, without asperities or prominences. Nevertheless the grains seem to have a tendency to agglutination, and appear to belong to the type of pollen grains best adapted to be collected by insects adhering to the body of any animal which might be in the habit of frequenting flowers, rather than to the type of pollen grains easily transported by winds. This appearance, which I have

⁵ Malesia, vol. II, t. XXXVIII, f. 1-3.

met with in the pollen grains of *Pr. affinis*, is probably common to all species of *Pritchardia*, considering the very small differences existing among their flowers. According to Professor Rock, the flowers of *Pritchardias* are much frequented by bees, wasps, and other insects; hence it is not improbable that birds also visit them to capture those insects; yet if the flowers of these palms do secrete a nectareous juice, it is presumable that the *Drepanidi*, the family of birds so peculiar to the Hawaiian Islands and which possesses a form of beak especially adapted for extracting nectar from the flowers of various plants, visit the *Pritchardias* as well, thus contributing indirectly to their fertilization.

It is also possible that some *Pritchardias* may produce two qualities of flowers from the same spadix; flowers which in appearance morphologically conform, but which are in fact functionally different. And with respect to this, Professor Rock has pointed out to me that in *Pr. Beccariana*, in *Pr. Martii*, and perhaps in some other species, only the uppermost branch of every spadix produces the fruits, while all the flowers on the lower branches fall off. Hence in these species we have spadices of a clearly heterogamous nature. But in the specimens of *Pr. Beccariana* examined I have not discovered any organic difference between the flowers from the lower branches and those from the upper part of the same spadix.

STRUCTURAL PECULIARITIES.

The diagnostic characteristics of the species of *Pritchardia* are found chiefly in the fruit, and in the indumentum which covers the leaves and the spadices. Characters which might serve to distinguish one species from another are hard to find in the flowers, as these conform to one type, with slight differences in size and in the venation of the calyx and of the corolla. Only *Pr. Wrightii* differs from the Polynesian species, its flowers being of a more fleshy nature than those of others of the entire group.

The leaves of *Pritchardia* are without stomata in their upper surface but almost always show some special covering or clothing on the lower. Only in a very few cases are they equally green and bare on both faces. The indumenta which cover the leaves and other parts of the plant are of two different kinds. One consists of a thin waxy coating, which takes the appearance of a fine white powder, easily removed, and which imparts to the petioles, to the backs of the leaves, and to parts of the spadices a powdery and glaucous shade more or less pronounced, as in *Pr. Thurstonii*, *Pr. Hillebrandi*, *Pr. Maideniana*, and *Pr. insignis*. The other far more common indumentum is due to the presence of a special kind of hairiness, or of dots like orbicular or oblong or variously shaped scales, which I have distinguished with the name "lepidia"⁶ and which are present on the leaves of many other palms. When the lepidia are very close together they form a complete covering, touching each other with their marginal cells, which in some cases take the shape

⁶ Webbia, vol. IV, p. 366, 1913.

of hairs, and contribute to form a continuous and thick felted clothing.⁷ In this latter case the lower surface of the leaves has a silvery or even subaureous appearance, as in *Pr. Rockiana*, *Pr. arecina*, *Pr. eriophora*, and *Pr. minor*. The greater or lesser abundance of the waxy coating, of lepidia, or of tomentum, whether on the leaves or on the spadices, should, I believe, be taken as the effect of the climatic conditions under which a plant is obliged to live, but perhaps depends to a still greater degree on the conditions of the environment in which the species was originally formed.

Species having glaucous and waxy leaves, such as *Pr. Hillebrandi* and *Pr. insignis*, may be presumed to be still influenced by the dry climate in which they were originally formed, the waxy coating being one of the most characteristic peculiarities of xerophilous plants. In the Hawaiian Islands the great rains and the thick shadows of the damp and wet forests seem to have been if not the only cause the most active stimulus in producing the subaureate or silvery clothing in the leaves of *Pr. Rockiana*, *Pr. arecina*; *Pr. eriophora*, *Pr. minor*; and *Pr. eriostachya*. The upper surface of the leaves of these species is green and devoid of any kind of hairiness and also of stomata. The hypothesis would therefore appear plausible that the great difference existing between the two surfaces is the result of a protective arrangement for the respiratory organs of the leaves, which are present on their lower surfaces only.

Also the soft and woolly hairiness that almost conceals the spadices of *Pr. eriophora*, *Pr. eriostachya*, and *Pr. minor* in their first youth, and of which they despoil themselves later, in part at least, is to be considered as a protective arrangement for their young flowers, against the excessive humidity of the swampy forests of the high mountains of Hawaii.

The appearance of the lower surface of the leaves of *Pritchardia* is shown in the following prospectus:

<i>Pr. pacifica</i>	Blade green with small elliptical lepidia.
<i>Pr. Thurstonii</i>	Blade waxy-glaucous and with small lepidia.
<i>Pr. Maideniana</i>	Blade waxy-glaucous and with small lepidia.
<i>Pr. Hillebrandi</i>	Blade distinctly waxy-glaucous without lepidia.
<i>Pr. insignis</i>	Blade distinctly waxy-glaucous without lepidia.
<i>Pr. remota</i>	Blade slightly waxy-glaucous and with rudimentary lepidia.
<i>Pr. affinis</i> (typica)	Blade green with punctiform lepidia.
<i>Pr. affinis</i> . v. <i>halophila</i>	Blade green with punctiform lepidia.
<i>Pr. affinis</i> v. <i>rhopalocarpa</i>	Blade green with punctiform lepidia.
<i>Pr. affinis</i> v. <i>gracilis</i>	Blade green without lepidia.
<i>Pr. lanaiensis</i>	Blade green with rusty, rather conspicuous punctiform or linear lepidia.
<i>Pr. glabrata</i>	Blade green with very small lepidia.

⁷ Malesia, vol. III, t. XXXVIII, f. 13 and 15.

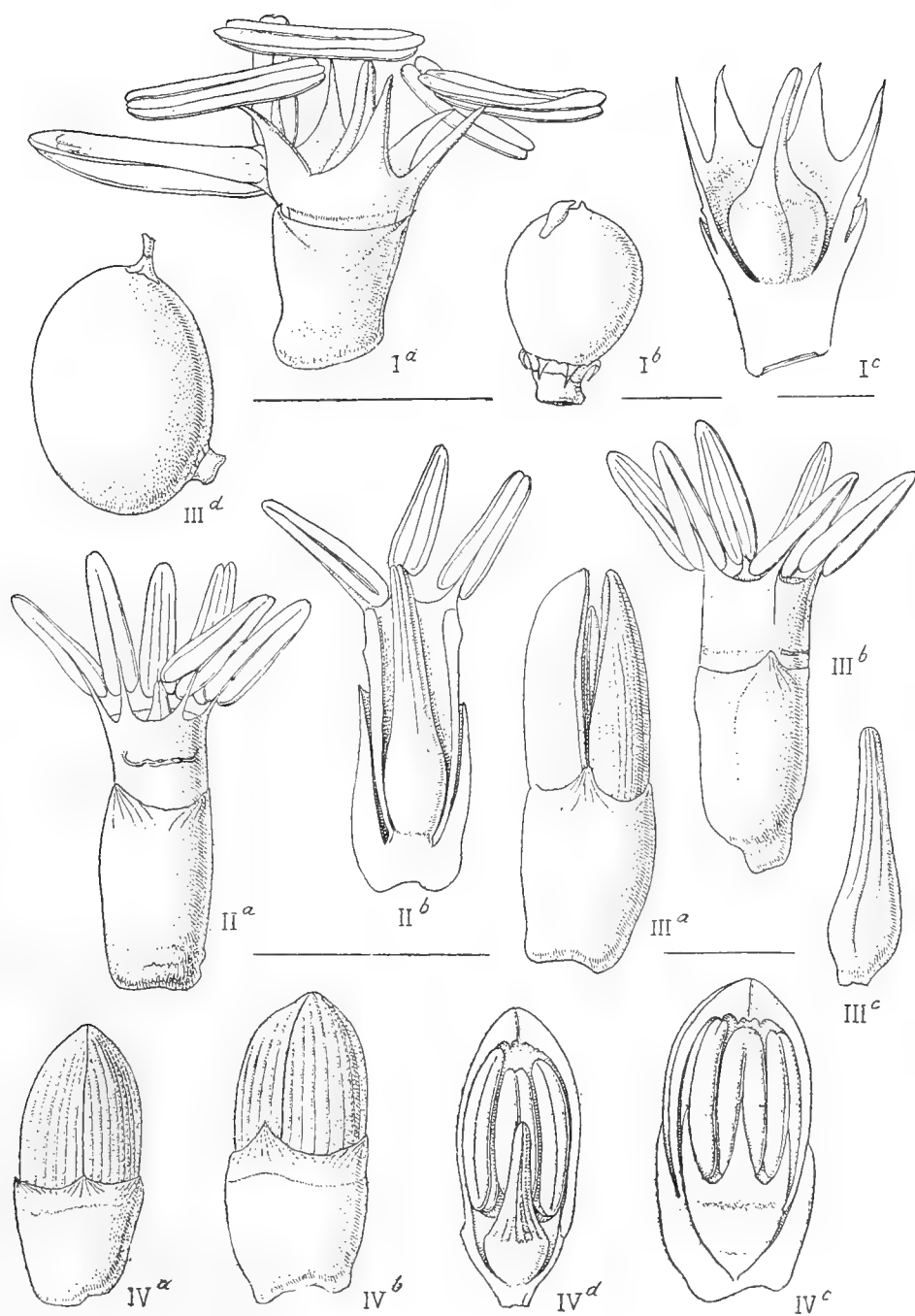


FIGURE 1. DIAGRAMS OF FLOWERS OF PRITCHARDIA: I. *Pritchardia Wrightii*: (Ia) Flower during the anthesis—one of the petals still attached to the corolla (enlarged 5 diameters). (Ib) Young fruit (enlarged). (Ic) Vertical section of a flower after fertilization (enlarged 5 diameters). II. *Pritchardia Beccariana*: Flower during the anthesis: (IIa) entire; (IIb) vertical section. (Both figures enlarged 5 diameters.) III. *Pritchardia Beccariana* var. *Giffardiana*: (IIIa) Flower before expansion; (IIIb) Flower during the anthesis; (IIIc) Ovary (a, b, c, enlarged 5 diameters); (IIId) Fruit (natural size). IV. *Pritchardia remota*: a, b, Flowers before the expansion; c, d, vertical sections of the same. (All figures enlarged 5 diameters.)

- Pr. macrocarpa* Blade green with minute lepidia.
Pr. Martii Blade tomentose from confluent fringed lepidia.
Pr. Gaudichaudii Blade rather closely covered with silvery, scalelike, elongate, non-confluent lepidia.
Pr. Lowreyana Blade green with punctiform lepidia.
Pr. Beccariana Blade green and densely dotted with elliptical, fringed lepidia.
Pr. Rockiana Blade subaureous-tomentose.
Pr. arecina Blade subaureous-tomentose.
Pr. lanigera Blade green and densely dotted with scalelike lepidia.
Pr. eriostachya Blade softly scaly-tomentose.
Pr. eriophora Blade subaureous-tomentose.
Pr. minor Blade subaureous or grayish-tomentose.
Pr. Vuylstekeana Blade equally green on both surfaces and without lepidia.
Pr. pericularum Blade equally green on both surfaces and without lepidia.
Pr. Wrightii Blade thinly tomentose.
Pr. Forbesiana Blade equally green on both surfaces, beneath with linear, rusty lepidia.
Pr. brevicalyx Blade equally green on both surfaces, sprinkled beneath with minute lepidia.



DISTRIBUTION OF PRITCHARDIA IN THE HAWAIIAN ISLANDS.

By JOSEPH F. ROCK.

TABLE OF DISTRIBUTION.

PRITCHARDIA	NIHOA	KAUAI	OAHU	MOLOKAI	MAUI	LANAI	HAWAII.
arecina					*		
affinis							*
var. gracilis							*
var. halophila							*
var. rhopalocarpa							*
Beccariana							*
var. Giffardiana							*
eriophora		*					
eristachya							*
Forbesiana					*		
Gaudichaudii				*			
Hardyi		*					
Hillebrandi				*?			
glabrata					*		
Lowreyana				*			
var. turbinata				*			
lanaiensis							
minor		*					
Martii			*				
macrocarpa			*				
remota							
Rockiana			*				
montis-kea							*
lanigera							*
Munroi				*			
kaalae			*				
viscosa		*					
brevicalyx				*			
kahanae			*				
martioides			*				

The distribution of the various species of *Pritchardia* occurring on the islands of the Hawaiian group from Nihoa to Hawaii proper, is sketched in the following pages.

LAYSAN ISLAND.

A single short-stemmed species of *Pritchardia* has been recorded from Laysan Island and also photographed by zoological collectors, but no specimens were collected, and therefore the identity of that palm cannot be ascertained. It would be very interesting indeed to learn the identity of the Laysan palm, which, according to the photograph examined, is a rather young plant, and must have reached that island through ocean currents. This would prove that *Pritchardia* seeds may be disseminated by ocean currents; that they are immune to the effects of salt water; and that they keep their germinating power for a considerable period. Laysan Island is strictly a coral island of low elevation. The palm found there was recorded as *Pr. Gaudichaudii*, but that is an error as all small fruited species were regarded as belonging to *Pritchardia Gaudichaudii*, and all large fruited species to *Pritchardia Martii* irrespective of the shape of the fruit, size of flowers and leaves and number of panicles in each spadix and whether the latter was glabrous or woolly or tomentose. It is very probable that the species found on Laysan is identical with *Pritchardia remota* Becc., a small fruited species found on Nihoa, a volcanic island, and not far distant from Laysan.

NIHOA OR BIRD ISLAND.

Nihoa is a volcanic island, situated in latitude $23^{\circ} 05' 50''$ N. and longitude $161^{\circ} 56' 30''$ W., and is about 400 miles north east of Kauai, considered the oldest island of the Hawaiian group. Little is known of the flora of Nihoa, but all navigators have reported a grove of palms. There are in fact several clumps of palms including about 150 individuals, growing in a sort of valley which extends from sea level to the top of the island which is 880 feet in height. Through the kindness of Captain Brown of the United States Revenue Cutter "Thetis," I secured complete material of the interesting and distinct species, described by Beccari as *Pritchardia remota*. The photograph obtained by Captain Brown is not suitable for reproduction, but it shows that the plants are exposed to the trade winds and gales; that the stems are flexuose and the crown very much ruffled.

Seeds of this species were first brought from Nihoa to Honolulu by a Doctor Rooke in 1858, and a tree grown from seed was planted in the Palace yard, now the grounds of the Executive Building.

KAUAI.

The island of Kauai is circular in outline and is composed of a central mountain mass which culminates in Mt. Waialeale at a height of 5250 feet. The leeward side slopes gently towards the sea and is intersected by deep canyons.

The windward side is precipitous, especially in the Napali region. This region is intersected by deep valleys as Wainiha, Kalihiwai, and in the Napali region by Hanakapiai, Kalalau and other valleys. So far Kauai has produced four species of *Pritchardia* but undoubtedly still others occur in some of the inaccessible mountain fastnesses on the precipitous leeward side. Two species occur on the lee side of the island. *Pritchardia eriophora* Becc. is found on the ridge west of Halemanu, known as Kaunuohua, at an elevation of 4200 feet near the cliffs overlooking Kalalau. (See Pl. XVIII, A.) It is a rather tall species 45 feet or more in height and grows in boggy soil associated with species of *Pelea*, as *Pelea anisata*, *Pelea microcarpa*, *Tetraplasandra Waimeae*, *Coreopsis cosmoides*, *Cheirodendron platyphyllum*, *Lysimachia glutinosa* and others. It is closely related to *Pritchardia minor* Becc. which occurs also on the leeward side. This is a smaller palm in stature but larger in crown; it occurs near Kaholuamano at an elevation of 3600 feet on steep slopes overlooking Mahana valley in a drier situation than *Pritchardia eriophora*.

In February, 1920, I again visited Kauai for the purpose of photographing palms. During this visit information furnished by natives and others whose business takes them into remote mountainous region, resulted in the discovery of two very distinct and new species. One was found near the so-called Pole Line Trail on Summit Camp at an elevation of 1900 feet. It is described in this paper as *Pritchardia Hardyi* Rock and is one of the tallest species, measuring about 70 feet in height. A few individuals were found. The one here pictured (see Pl. XIII, A) grew in a deep ravine; and so only a fourth of the actual trunk is visible in the photograph. This species is related to *Pritchardia minor* and with *Pritchardia eriophora* had a common origin. The fourth species, *Pritchardia viscosa* Rock, was discovered not very far from the Pole Line Trail but on the cliffs in a branch of Kalihiwai Valley at an elevation of about 2000 feet. This species is decidedly distinct and has very little in common with the other three species found on Kauai. It is unique among the Hawaiian species in its very viscous inflorescence. The trunk is not nearly as tall as in *Pritchardia eriophora* or *Pr. Hardyi*, measuring only about 20 feet in height. With the exception of *Pritchardia viscosa*, the other Kauai species are small fruited with elliptical, not spherical, fruits, while *Pritchardia viscosa* has obovate to pyriform large fruits. They are all shiny black when mature.

OAHU.

The island of Oahu which is separated from Kauai by a channel 60 miles wide, is divided into two main mountain ranges. The western one nearest to Kauai, is known as the Waianae range which culminates in Mt. Kaala, the highest point of Oahu, 4030 feet in height. The other range forms the main back bone of the island and is known as the Koolau range with mountains a little over 3000 feet in height. So far, only three species of *Pritchardia* have been found on Oahu. One, *Pritchardia kaalae* (see Pl. VI, A), is restricted to the Waianae

mountains, and especially to the left branch of Makaleha Valley, where it is found at about 1800 feet elevation at the foot of the cliffs forming Mt. Kaala. Several individuals form a beautiful grove on a small ridge leading to the cliffs of Kaala. The palms are about 25 feet in height and are remarkable for their exceedingly long inflorescence or spadix which measures over seven feet in length. The fruits are small in size as compared to those of the other two species found on Oahu. *Pritchardia Martii* (Gaud.) H. Wendl. is restricted to the Koolau range, where it occurs near the summit of that range and on the ridges of valleys leading to the crest of it. It extends from Wailupe Valley to Niu, Palolo, Moanalua and Waiahole valleys, where it grows on the steep cliffs. So far it has not been found beyond Waiahole, but in all probability it extends to Kahana. At Kuliouou, the easternmost valley of the Koolau range, on the windward side, and on windswept absolutely barren ridges there occur clumps of palms which may be *Pritchardia Martii*, but owing to the inaccessibility of the vertical, barren cliffs, no specimens were collected. *Pritchardia Rockiana* Becc. is confined to the windward side of the Koolau range and especially to the mountains back of Punaluu and Hauula in the dense rain forest in the western half of the range. It differs from *Pr. Martii* in the large obpyriform fruits and densely tomentose panicles. It is short in stature like *Pritchardia Martii* but the trunk is stouter, light gray and smooth. From Nuuanu Valley, which divides the Koolau range into a western and an eastern part, Dr. W. Hillebrand records a species which he referred erroneously to *Pritchardia Martii*. This species was published by Linden in 1876 as *Pritchardia macrocarpa* (see Pl. XII, A). It exists now only as a cultivated species in the older gardens of Honolulu and only five or six individuals are extant. Regarding this species Hillebrand remarks: "In Nuuanu where until a recent time two clumps could be seen from the upper part of the valley, one was completely exterminated when the natives found that the trees were salable to amateurs of gardening in Honolulu; the other owes its preservation to the absolute inaccessibility of the cliff on which it stands." No specimens, however, can be seen now in that valley and *Pritchardia macrocarpa* exists as far as is known now as a cultivated species only. The specimen reproduced here grows in the garden of Mrs. Mary E. Foster on Nuuanu Avenue, the former premises of Dr. W. Hillebrand, who planted two specimens of this species which bear profusely.

MOLOKAI.

The island of Molokai is oblong in outline and is composed of two distinct parts which once were undoubtedly separate islands. The west end nearest to Oahu and separated from that island by a channel twenty miles wide is quite bare and without tree growth, save a few scattered individuals the remnants of a semi-xerophytic forest. There are of course no *Pritchardias* in that region. The eastern part of the island with its vertical cliffs on the windward side and its deep ravines as Waihanau, Waikolu, Waialeia, Pelekunu, Wailau, and

Halawa, and its even, although steep, slope on the lee side, is the region in which *Pritchardias* abound. The most common species found on Molokai is *Pritchardia Gaudichaudii* (Mart.) Seem. et Wendl. It occurs not only in practically all the valleys on the windward side but also on the rock islets off the coast of Molokai. It seems to be a variable species which loves the windswept, weather-beaten cliffs, as the accompanying illustration testifies (see Pl. VIII, *A*). It clings to sheer walls where hardly any other vegetation can take hold. I observed it growing in a straight line, one tree above another, along the precipitous walls of a waterfall without the sign of any other tree or even shrub. On the steep walls or cliffs which rise vertically from a deep sea this species abounds, with *Pandanus tectorius* as well as on Haupu and Huela, two spurs jutting out into the sea from the main cliffs. One of the islets off the coast harbors several specimens of this species.

On the ridge dividing Waihanau Valley from Waialeia Valley, *Pritchardia Gaudichaudii* is quite common, but only on the slopes towards the sea, while a little further inland on the flats occurs another and very distinct species, *Pritchardia Lowreyana* Rock. It is a much larger palm but of short stature and has the largest fruits of any species in the genus. These two species had undoubtedly a common origin. A new variety recently discovered by me in the same locality grow in company with *Pritchardia Gaudichaudii* nearer the edge of the cliffs immediately above the sea but at a height of about 3,000 feet. This variety must be referred to *Pritchardia Lowreyana* Rock; it differs from the species in the smaller fruits, which are pointed at both ends, in the smaller stature of the palm, and in the shorter spadices.

The lee side of Molokai, back of Kamolo, is intersected by several ravines which are more or less shallow; the actual slopes are, however, practically barren and covered with loose volcanic rocks up to nearly 2,000 feet elevation. In that region *Dodonaea eriocarpa* is very common and some xerophytic trees as *Dracaena aurea*, *Xanthoxylum maiiense*, *Osmanthus sandwicensis*, *Sideroxylon sandwicense* var. *molokaiense*. At the two thousand-foot level *Dodonaea stenoptera* is very common and especially at Puakoolau and Kamolo proper. The region must be considered a subxerophytic one although a thousand feet higher the rain forest commences. It was in this subxerophytic region that another new *Pritchardia* was discovered. It is herein described as *Pr. Munroi* Rock, in honor of Mr. James Munro to whom I am greatly indebted for many courtesies and hospitality. (See Pl. XIV, *A*.)

The species is exceedingly interesting, as it is one of the few occurring in semi-arid regions. It is a small palm, with very short woolly panicles and perfectly spherical small brown fruits. The costae on the under side of the leaf are covered with large and robust brownish-green scales such as have not been observed in any other species.

Pritchardia brevicalyx, also a newly discovered species, occurs in Wailau

Valley on the windward side of Molokai, where it grows in similar locations as *Pritchardia Gaudichaudii*. It is also cultivated by the natives of Wailau in front of their houses.

MAUI.

The island of Maui is composed of two distinct mountain masses, West Maui and East Maui. It has, so far as is known, only three species of *Pritchardia*. The eastern part of Maui is made up of the great mountain mass known as Haleakala, one of the largest extinct craters in the world. This mountain, rising to a height of little over 10,000 feet, is younger than the western part of Maui, which is deeply intersected on all sides by ravines and gorges, the highest points being Puu Kukui, nearly 6,000 feet, and Mauna Ee'ke, over 4,000 feet in height. Two species of *Pritchardia* have been found in this region. The most distinct species found on Maui is *Pritchardia arecina*, which occurs on the windward side at an elevation of about 3,000 feet back of Honomanu and Nahiku in dense rain forests. This species, while very distinct, shows a decided relationship to *Pritchardia lanigera* of the Kohala mountains of Hawaii, separated from East Maui by a channel forty miles wide. The other species, *Pritchardia glabrata* and *Pritchardia Forbesiana*, are restricted to the rain forests of West Maui, the former to the lateral branches of Iao Valley, and the latter to the drainage basin of Honokahau immediately below Mauna Ee'ke, an open bog of over 4,000 feet elevation (see Pl. IX, A). It is interesting to note that *Pritchardia Forbesiana* is very closely related to *Pritchardia Gaudichaudii* so common on Molokai and only a few miles distant from the west end of Maui. Undoubtedly the valleys of Waihee, Honokawai, and Olowalu, of the west end, and the mountains back of Keanae and Kipahulu will furnish additional species, since it has been found that each species is very precinctive indeed, being confined not only to one island but to certain valleys or circumscribed areas.

LANAI.

This comparatively small island harbors at least one distinct species, *Pritchardia Lanaiensis*; but there is a strong suspicion of a second species occurring there, as among the fruits of the above-mentioned species deposited in the B. P. Bishop Museum Herbarium there are some which do not belong to *Pritchardia lanaiensis*, but belong to an entirely different plant. The mature fruits, which I have carefully examined, are different from any known to me and I designated this otherwise incompletely known species as *Pritchardia elliptica* Rock. According to the accompanying note it occurs at the eastern end of that island, while *Pritchardia lanaiensis* grows on the windward side at the head of Mauna Lei gorge and also on the edge of the canyon Nahoku, where I observed a number of individuals.

HAWAII.

The largest and youngest island of the Hawaiian group with three huge mountain masses rising to a height of nearly 14,000 feet and another formidable mountain mass much older than the three volcanoes mentioned, harbors the largest number of species of *Pritchardia*. The Kohala mountains are deeply intersected by numerous ravines on the windward side, while the summit is a flat plateau with a very stunted vegetation and dotted with volcanic cones covered with verdure. It is on this plateau that we find *Pritchardia lanigera* scattered usually as single individuals. It does, however, extend into the dense forests back of Awini on the windward side. So far this is the only species recorded from the Kohala mountains. It was first discovered by Lydgate and was re-collected by me in 1910 above Awini, and recently (March, 1920) on the high plateau back of Waipio Valley at an elevation of 4,000 feet.

Nearest to this locality on the slopes of Mauna Kea facing the Kohala mountains between Mana and Honokaa, I discovered a species allied to *Pritchardia lanigera*. It is a taller species with very large fruits. Unfortunately it is on the verge of being exterminated. Only a few individuals are still extant and they are in a most precarious condition. The forest, their natural environment, has been wholly destroyed, not a vestige of their former associates being left, save a few dead trunks and scattered branches. I discovered this interesting species in 1909 but at the time of my visit none of the three specimens then seen bore either flowers or fruits. I made a special trip to this locality eleven years later and succeeded in locating a single individual which is here photographically reproduced. (See Pl. XVI, A.) It is described in this paper for the first time under the name *Pritchardia montis-kea*.

Another very interesting species which occurs as numerous individuals throughout the forests above and below Glenwood between the slopes of Mauna Loa and Mauna Kea at an elevation of about 2,000 feet is *Pritchardia Beccariana*, first discovered by me in 1914. (See Pl. XI, A.) It is a very glabrous species, and perhaps the tallest found in these islands. It inhabits the dense rain forests, which are mostly composed of *Metrosideros collina polymorpha*, and towers sometimes above these trees. Its dimensions are huge, young leaves measuring ten feet in diameter. At a somewhat higher elevation, about 3,000 feet, this species is represented by a variety of smaller dimension in every respect, but otherwise not materially different from it. It is described by Doctor Beccari as var. *Giffardiana*. The next locality where the genus is again represented is on the southern slopes of Mauna Loa in the rain forests of Kau above Naalehu at an elevation of 3,000 feet. It was discovered by me in 1912 and described by Beccari as *Pritchardia eriostachya*. It is related to *Pritchardia montis-kea* and *Pritchardia lanigera* but differs from both in many respects.

In South Kona, also on the southern slopes of Mauna Loa but in the drier belt where rain is much less frequent than at Glenwood and in the Naalehu

forest, there occur apparently two species and three varieties of one. There is no question that South Kona is the home of *Pritchardia affinis*, also a newly described species, hitherto confused with *Pritchardia Gaudichaudii*. Tall specimens seventy-five feet in height occur at Kaohe and Opihale and also at Kealia. (See Pl. III, A.) The original forest surrounding this species has practically disappeared with the exception of a few tree ferns and a few *Metrosideros* trees.

The palms were saved from the ax on account of their usefulness, the natives employing the young leaves in the making of hats, and the young seeds though not particularly palatable are eagerly sought by them. Several varieties of *Pritchardia affinis* are found on Hawaii, var. *rhopalocarpa* at Kealakekua (see Pl. IV, B), var. *halophila* at Kalapana, and var. *gracilis* at Kiholo in North Kona.

THE USES OF PRITCHARDIA.

By JOSEPH F. ROCK.

The Hawaiians have evidently always employed the leaves of the species of *Pritchardia* occurring in Hawaii. But probably only since the arrival of the white man in these islands have they learned the braiding of the young leaves into hats. The natives have two names for Hawaiian *Pritchardias*, *Loulu lelo* and *Loulu hiwa*, and consequently only two species are recognized by them. Hillebrand states that *Loulu lelo* is the palm found on the northern coast of Molokai and this would indicate that it is *Pritchardia Gaudichaudii*, while *Loulu hiwa* is in all probability *Pritchardia Hillebrandii*. The young leaves of this latter palm are especially preferred by the Hawaiians for the making of hats, as they are of a bluish white and have no scale-like lepidia of any sort on their under-surfaces, but are covered with a glaucous waxy-powdery substance. It is the most commonly cultivated species, although *Pritchardia affinis* is also very often met with near Hawaiian dwellings.

The seeds of all the species are used by the natives for food, but only in an immature state, the kernel having somewhat the taste of coconut. The seeds are known to the Hawaiians as *Hawane* and also *Wahane*. The latter name recurs at the Marquesas Islands as the name of *Pritchardia pacifica*, which is said to occur there. Owing to the seeds being much sought by natives and children, while still immature, it is often very difficult to find ripe fruits, and even in the mountains mature seeds are very scarce owing to rats and mongooses which eat the fruits as soon as they have fallen. The trees are also often mutilated by the natives and deprived of their leaves with the exception of one or two at the apex of the trunk. There is no doubt that some of the species are on the verge of extinction, as for example *Pritchardia montis-keā* and others. Of many of the species not a single young plant could be found beneath them. If seeds do escape the ravages of rats, the young plants resulting are dug up and eagerly devoured by wild pigs. Insects have been found to attack the young fruits of

Pritchardia Beccariana and it is difficult indeed to find young plants. Mature plants of this latter species abound near Glenwood and at Hale loulu on Hawaii, which fact, however, does not warrant the cutting down of these beautiful objects in order to build fences with their trunks. Such practice should be forbidden.



PART II.—SYSTEMATIC TREATMENT.

By ODOARDO BECCARI and JOSEPH F. ROCK.

THE GENUS PRITCHARDIA.

Pritchardia Seem. et H. Wendl. in Bonpl. IX, 260; X, 197, 310, t. 15; Benth. et Hook. Gen. Pl. III, 928; Becc. Malesia, III, 286, t. XXXVII, XXXVIII, and in Webbia, II (1907), 200, and III (1910), 137, and IV (1913), 202, f. 12-17; Rock, Indig. Trees Haw. Isls. (1913), 99-107, pl. 32-33; Blatter, Palms Brit. Ind. in Journ. Bomb. Nat. Hist. Soc., March 31, 1912, 357, pl. XXIX; Baill. Hist. des Pl. XIII, 319 (in part).

Pritchardia Colpothrinax Gris. et Wendl. in Bot. Zeit. 1897, 147; Benth. et Hook. Gen. Pl. III, 927; Drude in Engl. et Pr. Pflanzenf. II, 3 (1889), 33; Baill. Hist. des Pl. XIII, 315.

Pritchardia Washingtonia sp. O. Kuntze Rev. Gen. Pl. II (1891), 737.

Pritchardia eupritchardia O. Kuntze Rev. Gen. Pl. III, 2 (1898), 323.

Arboreous unarmed palms with solitary, naked, ringed stems. *Leaves* terminal, large, the old ones deciduous; the blade flabellate, expanded in outline for a more or less extensive portion of a circle, usually broadly cuneate at the base, undivided in the central part, and more or less deeply multifid on the periphery; the segments more or less deeply bifid, usually, with interposed filaments; the upper face of the blade is devoid of stomata. Petioles always unarmed, ligulate at apex anticously, and passing behind without interruption into a short rachis. The majority of the mid-costas of the segments start from the apex of the petioles, but some also from the sides of the rachis. *Spadices* interfoliaceous, composed of one panicle only, more or less, branched, or, at times, of 2-4 distinct similar panicles, each of which is borne on the end of a distinct peduncular part; *spathes* several, coriaceous, the lower sheaths the peduncular part, and the upper ones (2 or more in number) are concave, lanceolate, boat-shaped, or ass's-ear-like, and embrace the flowering panicle. *Flowers* hermaphrodite, scattered, or else spirally arranged on the branchlets and solitary (never glomerulate) and sessile on bracteate pulvinuli; special floral bracteolae none. *Calyx* tubular or cyathiform-companulate, more or less solid in its lower portion; the limb slightly 3-toothed. Corolla considerably longer than the calyx; it has a permanent tube, and three valvate divisions, the latter deciduous at the time of anthesis. Stamens 6; the filaments with their united bases form at the faux of the corolla, a ring, crowned by six filamentose subulate apices; anthers linear, or linear-oblong, or linea-sagittate, dorsifix, at first erect, versatile during anthesis, dehiscing internally. Ovary conical, ovate, obovate, or else turbinate; composed of three half free, uniovulate carpels; the latter deeply sculptured above,

and united into an elongate trigonous style, which has a nearly common punctiform stigma. Ovules solitary in the carpels, basilar, erect, anatropous. *Fruit* always produced from the development of one carpel only, globular or ovoid, regular, or very slightly asymmetrical at the base, and having the remnants of the sterile carpels and the style at apex. The whole pericarp is generally not very thick; the epicarp has a smooth surface; the mesocarp is slightly fleshy or grumous, or else more or less traversed by longitudinal fibres; endocarp woody, equally thin all around, but frequently thickened at the base, sometimes easily separating from the mesocarp at complete maturity. *Seed* globular, erect, and free in the endocarp cavity; hilum basilar raphe obscure or slightly impressed, occupying a whole side of the seed, with very few faint, or wholly obsolete vascular branches; the integument slightly more thickened on the raphe side than elsewhere, but not penetrating into the substance of the albumen; albumen homogeneous; embryo basilar, placed near the hilum, or else shifted toward the middle of the antiraphe side.

Fruiting perianth persistent, hardened, not, or very slightly, accrescent, more or less pedicelliform.

CONSPECTUS OF THE SPECIES.⁸

I. Flowers exsuccous or coriaceous. (Polynesian species.)

A. Floriferous branchlets glabrous.

a. Fruit globous, small (7 to 14 mm. in diameter).

b. Leaf-blade green underneath and dotted there with small elliptical, superficial lepidia. Spadices shorter than the leaves. Unopened flowers 7 to 7.5 mm. long. Fruit 12 mm. in diameter; pericarp 1.3 mm. thick
 1. PRITCHARDIA PACIFICA Seem. et Wendl.—Fiji.

b.¹ Flowers smaller than in the type. Fruit with a thicker pericarp . .
 PR. PACIFICA var. SAMOENSIS Becc., cultivated in Samoa.

b.² Leaf-blade waxy-glaucous beneath, and dotted there with small elliptical lepidia, which nest in depressions of the epidermis. Spadices longer than the leaves. Unopened flowers 5 to 5.5 mm. long. Fruit 7 mm. in diameter
 2. PRITCHARDIA THURSTONII F. Muell. et Drude.—Fiji.

b.³ Leaf-blade very obsoletely waxy-glaucous beneath and dotted there not closely with small elliptical, brown lepidia. Unopened flowers 10 to 11 mm. long; the calyx 3 mm. long; the corolla three times as long as the calyx. Floriferous branchlets relatively thick (4 to 5 mm. in diameter). Fruit 12 to 14 mm. in diameter
 3. PRITCHARDIA MAIDENIANA Becc. The precise locality unknown. Probably from some of the lower Polynesian Islands.

⁸ This conspectus was arranged by Doctor Beccari; Professor Rock is, however, responsible for the keys to the following species: No. 11, *Pr. kaalae*; No. 14, *Pr. Forbesiana*; No. 19, *Pr. Hardyi*; No. 20, *Pr. Munroi*; No. 22, *Pr. montis-kea*; and No. 23, *Pr. viscosa*.

- a.*¹ Fruit mediocre, 18 to 23 mm. in diameter; spherical or nearly so, (not exactly known of *PRITCHARDIA GLABRATA*).
- b.* Leaf-blade more or less powdery waxy or glaucescent beneath.
- c.* Leaf-blade distinctly waxy-pulverulent and devoid of lepidia beneath. Panicle having the lower branches digitately 3 to 4-partite. Floriferous branchlets rather slender. Calyx of a hard nearly woody structure, especially at the base, very faintly veined in its upper part only; petals very faintly striate outside. Fruit globose, usually slightly longer than broad (18 to 20 by 17 to 19 mm.). Fruiting perianth conspicuously pedicelliform, cylindrical, 4 mm. long and high 4. *PRITCHARDIA HILLEBRANDI* Becc.—Hawaiian Islands.
- c.*¹ Leaf-blade slightly powdery-waxy and devoid of lepidia beneath. Panicle composed of few simple or slightly divided, thickish (4 to 5 mm. through), polished, floriferous branchlets. Calyx not veined, of a hard texture. Fruit spherical, 14 to 16 mm. in diameter. Fruiting perianth pedicelliform, subcampanulate 5. *PRITCHARDIA INSIGNIS* Becc.—The precise locality unknown. Possibly from some of the Hawaiian Islands.
- c.*² Leaf-blade slightly powdery-waxy and dotted with small, almost rudimentary, lepidia beneath. Panicle elongate, much branched, the lower branches divided into 10 to 12 slender floriferous branchlets. Petals conspicuously pluri-costulate. Fruit nearly spherical, 19 to 20 mm. long, 18 to 19 mm. in diameter. Fruiting perianth 4 mm. high, ventricose-pedicelliform 6. *PRITCHARDIA REMOTA* Becc.—Nihoa or Bird Island (Hawaiian Islands).
(not powdery-waxy).
- b.*¹ Leaf-blade green on both surfaces or only paler beneath than above
- c.* A tall plant. Leaf-blade rather closely dotted beneath with small, orbicular, or oblong lepidia. Calyx nearly smooth, of a hard texture and nearly woody at the base. Fruit spherical or a trifle narrowed to the base, 23 mm. in diameter. Fruiting perianth pedicelliform, cylindrical or slightly campanulate 7. *PRITCHARDIA AFFINIS* Becc. (forma typica).—Hawaii.
- c.*¹ A smaller plant than the type. Leaf-blade dotted with minute, spaced lepidia. Fruit spherical 20 to 21 mm. in diameter *PR. AFFINIS* var. *HALOPHILA* Becc.—Hawaii.
- c.*² Leaf-blade sparingly dotted on the lower surface with very small lepidia. The ripe fruit subspherical, the immature one obovate, distinctly narrowed to the base, 25 mm. long, 20 to 22 mm. in diameter *PR. AFFINIS* var. *RHOPALOCARPA* Becc.—Hawaii.
- c.*³ Rather small, 3 to 4 mm. high. Leaf-blade devoid of lepidia. Fruit obovate, distinctly narrowed to the base, 20 to 22 mm. long, 16 to 17 mm. in diameter *PR. AFFINIS* var. *GRACILIS* Becc.—Hawaii.

- c.*⁴ Leaf-blade spotted beneath with punctiform, or else very narrowly linear, rusty lepidia. Floriferous branchlets slender bearing nearly regularly bifarious flowers; calyx campanulate, fleshy-coriaceous, conspicuously veined. Fruit spherical, 2 cm. in diameter. Fruiting perianth nearly explanate (not pedicelliform)
8. *PRITCHARDIA LANAIENSIS* Becc. et Rock.—Lanai (Hawaiian Islands).
- c.*⁵ Small. Leaf-blade quite glabrous, yet dotted beneath with small, orbicular, not fringed lepidia. Floriferous branchlets slender. Unopened flowers acuminate; calyx campanulate, fleshy-coriaceous, sharply veined. Fruit perhaps smaller than that of the other species of the group, ovoid when young. Fruiting perianth somewhat depressed, with the callous remains of the corolla tube spreading
9. *PRITCHARDIA GLABRATA* Becc. et Rock—Maui (Hawaiian Islands).
- a.*² Fruit relatively large, 3 cm. or more long.
- b.* Leaf-blade green and dotted beneath with very minute, orbicular or elliptical, pale, not fringed lepidia. Fruiting perianth depressedly pedicelliform, with the remains of the corolla tube and saminal ring inconspicuous. Fruit obovate, narrowed to the base, 4 to 4.5 cm. long, 3 to 3.5 cm. in diameter. Short stemmed
10. *PRITCHARDIA MACROCARPA* Linden—Oahu (Hawaiian Islands).
- b.*¹ Leaf-blade large, dark green on both sides, dotted beneath rather closely with elliptical, slightly fringed, pale lepidia. Spadix 2.5 m. long, twice branching. Fruit 3 cm. long, 2 cm. thick, pear-shaped. Tall stemmed
11. *PRITCHARDIA KAALAE* Rock—Oahu (Hawaiian Islands).
- b.*² Leaf-blade clothed beneath with an appressed tomentum composed of irregular, conspicuously fringed, confluent lepidia. Fruit not thoroughly mature(?), regularly elliptical, narrowed at both ends, but especially above, and pointed, about 4 cm. long, and 28 mm. in diameter. Fruiting perianth with a depressed, callous, shortly pedicelliform base, and the remains of the corolla tube and staminal ring split into several conspicuous pieces and spreading
12. *PRITCHARDIA MARTII* (Gaud.) H. Wendl.—Oahu (Hawaiian Islands).
- b.*³ Leaf-blade furnished beneath with rather closely but not confluent, relatively large, scale-like, silvery, elongate, slightly fringed lepidia. Fruit regularly spherical. A short stemmed palm
13. *PRITCHARDIA GAUDICHAUDII* H. Wendl.—Molokai (Hawaiian Is.)
- b.*⁴ Leaf-blade dotted beneath with elliptical, scale-like subentire yellowish lepidia. Spathes densely covered outside with a detachable brown wool. Flowers small, calyx subtruncate. Fruit ovoid to subglobose 4 to 4.5 cm. long, 3.2 to 3.5 cm. thick
14. *PRITCHARDIA FORBESIANA* Rock—Maui (Hawaiian Islands).

- b.*⁵ Leaf-blade green on both surfaces, dotted beneath with minute, punctiform, not fringed lepidia. Fruit large regularly ovoid, rounded at the base and conically pointed, 6 cm. long, 4 cm. through. A short stemmed palm
15. *PRITCHARDIA LOWREYANA* Rock—Molokai (Hawaiian Islands).
- b.*⁶ A smaller plant than the type, fruits smaller 4.5 to 5 cm. long, nearly 3 cm. through, pointed at both ends
- PR. LOWREYANA* var. *TURBINATA* Rock—Molokai (Hawaiian Islands).
- b.*⁷ Leaf-blade darker green beneath dotted with numerous narrow-elongate opaque, sulphur-yellow, thick, non-fringed lepidia. Flowers large, the calyx very short, petals excluded from the calyx. Fruit obovate, 4.5 cm. long, 3.2 cm. in diameter
16. *PRITCHARDIA BREVICALYX* Becc. et Rock—Molokai (Hawaiian Is.)
- b.*⁸ Leaf-blade green and rather densely dotted beneath with small elliptical lepidia, the latter having hyaline fringed margins. Flowers 12 to 13 mm. long. Fruit globose-oblong, somewhat asymmetrical at the base, 3-3.5 cm. long, 2.5 to 3 cm. through. A tall palm
17. *PRITCHARDIA BECCARIANA* Rock—Hawaii (Hawaiian Islands).
- b.*⁹ A smaller plant than the type. Flowers slightly smaller
- *PR. BECCARIANA* var. *GIFFARDIANA* Becc. Hawaii
- A.*¹ Floriferous branchlets thinly but permanently, rusty-tomentose. Leaf-blade subaureous tomentose beneath.
- a.* Fruit large obpyriform, 5 cm. long, 3 cm. in diameter. Panicle large spreading with subhorizontal thick branches
- 18. *PRITCHARDIA ROCKIANA* Becc.—Oahu (Hawaiian Islands).
- a.*¹ Fruit small obovoid, 2 cm. long, 16 mm. in diameter. Panicles with erect, simple, slender branches
- 19. *PRITCHARDIA HARDYI* Rock—Kauai (Hawaiian Islands).
- A.*² Floriferous branchlets densely and permanently villose.
- a.* Fruits small, globose 22 mm. long, 20 mm. in diameter. Spadix short, twice-branched, panicle 12 cm. Leaf-blade dotted beneath with small, elongate, entire, hyaline lepidia
- 20. *PRITCHARDIA MUNROI* Rock—Molokai (Hawaiian Islands)
- a.*¹ Fruits larger, 3.5 to 4.5 to 5.5 cm. long.
- b.* Calyx hairy-subtomentose.
- c.* Leaf-blade subaureous-tomentose beneath. Unopened flowers 12 to 14 mm. long. Fruit large, slightly irregularly globose, a little longer than broad (4.5 cm. long, and nearly 4 cm. in diameter)
21. *PRITCHARDIA ARECINA* Becc.—Maui (Hawaiian Islands).
- c.*¹ Leaf-blade green beneath but with few scattered, long-elliptical, hyaline lepidia. Fruit 5.5 cm. long, 4 cm. in diameter, obovoid, panicles with thick, horizontal, woolly branches

- . 22. *PRITCHARDIA ARECINA* Becc.—Maui (Hawaiian Islands).
*b.*¹ Calyx and corolla thickly viscous as if varnished.
 Leaf-blade densely tomentose with appressed confluent fringed lepidia.
 Fruit elliptical-pyriform, 4 cm. long, 2.5 cm. in diameter
 23. *PRITCHARDIA VISCOSA* Rock—Kauai (Hawaiian Islands).
*b.*² Calyx glabrous.
c. Leaf-blade closely dotted beneath with small appressed, scale-like
 orbicular or oblong lepidia. Petioles and spathes clothed with a
 copious floccose greyish, amianth-like more or less permanent tomen-
 tum. Fruit apparently ovoid and rather large (not known at perfect
 maturity)
 24. *PRITCHARDIA LANIGERA* Becc.—Hawaii (Hawaiian Islands).
*c.*¹ Leaf-blade softly scaly-tomentose beneath. Peduncular part of the
 spadix and spathes clothed with a copious, soft rufous woolliness.
 Fruit ovoid-ellipsoidal or slightly obovoid, 3.5 to 4 cm. long (including
 the pedicelliform perianth) and 26 to 28 mm. in diameter
 25. *PRITCHARDIA ERIOSTACHIYA* Becc.—Hawaii (Hawaiian Is.)
- B. Floriferous branchlets clothed with a dense floccose detachable woolliness.
a. Leaf-blade tomentose-subareous beneath. Floriferous branchlets short
 (2.5 cm. long) bearing rather distant, spirally alternate flowers. Fruit ellip-
 tical-subfusiform, conical above and acute at the base, 2.5 to 3 cm. long,
 12 to 13 mm. in diameter
 26. *PRITCHARDIA ERIOPHORA* Becc.—Kauai (Hawaiian Islands).
*a.*¹ Leaf-blade greyish or subareous and softly tomentose beneath. Florif-
 erous branchlets 4 to 7 cm. long with spirally, rather closely set flowers
 Fruit small, ovoid-ellipsoidal or subobovoid, rounded above and narrowed
 to the base, 18 to 20 mm. long, 12 to 13 mm. in diameter
 27. *PRITCHARDIA MINOR* Becc.—Kauai (Hawaiian Islands)
 Of the two following species only the fruits and the young leaves of culti-
 vated species are known.
- A. Fruit oblong, 24 mm. long, 18 mm. in diameter. Seed 15 mm. long, 14 mm.
 thick. Leaf-blade green on both surfaces, devoid of lepidia
 28. *PRITCHARDIA VUYLSTEKEANA* H. Wendl. Paumotu Islands.
- B. Fruit nearly spherical, 20 mm. long, 18 mm. in diameter. Seed 14 mm.
 long, 13 mm. thick. Leaf-blade as in the preceding
 29. *PRITCHARDIA PERICULARUM* H. Wendl. Paumotu Islands.
- II. Flowers fleshy—(Neogeous).
 A tall palm with a stem swollen and bottle-shaped in its lower part, and slender

above. Leaf-blade, thinly tomentose beneath. Fruit globose, 15 to 18 mm. in diameter

30. *PRITCHARDIA WRIGHTII* (Gris. et Wendl.) Becc.—Cuba and Isla de Pinos.

31. *PRITCHARDIA AUREA* Hort. Linden—Known only as a cultivated plant and in a sterile condition. Doubtful species.

SYNONYMS, DOUBTFUL AND EXCLUDED SPECIES.

PRITCHARDIA AUREA Hort. Lind.; Revue Hort. 1878, 186, Quid? Patria?

. . . . *borneensis* Hort. Lind. ex Gard. Chron. 18th March 1893, 332 (name only). (A species of *Licuala*?)

. . . . *Cusiniana* Hort. Lind. ex Pfister, Sabaleenbl. 31=*Livistonae* sp.

. . . . *filamentosa* H. Wendl. in Bot. Zeit. XXXIV (1876) 807=*Washingtonia filifera* H. Wendl.

. . . . *filifera* Linden ex André in Illust. Hort. XXIV (1877) 32. 105=*Washingtonia filifera* H. Wendl.

. . . . *grandis* Hort. Bull. ex Gardn. Chron. 1874, I, 415; Revue Hort. 1884, 28=*Licuala grandis* H. Wendl.

. . . . *grandis* Hort. Veitch.=*Licuala orbicularis* Becc. (*L. Veitchii* W. Watson in Gardn. Chr. 1886, Jan. 139).

. . . . *Moensii* Hort.; Revue Hort. 1883, 206 (name only) Becc. Malesia, III, 300 (Said to be a native of Paumotu. To be compared with *P. Vouylstekeana* or *P. pericularum*).

. . . . *nobilis* Hort.; Revue Hort. 1881, 384; Revue de l'Hort. Belge, 1882, 12. Quid?

. . . . *robusta* Hort.=*Washingtonia robusta* H. Wendl.

COLPOTHRINAX WRIGHTII Gris. et Wendl. in Pl. Cub. Wrigh. No. 3964=*Pritchardia Wrightii* Becc.

EUPRITCHARDIA GAUDICHAUDII O. Kuntze, Rev. Gen. Pl. III, 2. (1898) 323=*Pritchardia Gaudichaudii* H. Wendl.

. . . . *Hillebrandi* O. Kuntze, Rev. Gen. Pl. III, 2. (1898) 323=*Pritchardia Hillebrandi* Becc.

. . . . *lanigera* O. Kuntze, Rev. Gen. Pl. III, 2 (1898) 323=*Pritchardia lanigera* Becc.

. . . . *Martii* O. Kuntze, Rev. Gen. Pl. III, 2 (1898) 323=*Pritchardia Martii* H. Wendl.

. . . . *pacifica* O. Kuntze, Rev. Gen. Pl. III, 2 (1898) 323=*Pritchardia pacifica* Seem. et H. Wendl.

. . . . *remota* O. Kuntze, Rev. Gen. Pl. III, 2 (1898) 323=*Pritchardia remota* Becc.

. . . . *Thurstonii* O. Kuntze, Rev. Gen. Pl. III, 3 (1898) 737=*Pritchardia Thurstonii* F. Muell. et Drude.

- WASHINGTONIA HILLEBRANDI O. Kuntze, Rev. Gen. Pl. II (1891) 737=*Pritchardia Hillebrandi* Becc.
. . . . *Gaudichaudii* O. Kuntze, Rev. Gen. Pl. II (1891) 737=*Pritchardia Gaudichaudii* H. Wendl.
. . . . *lanigera* O. Kuntze, Rev. Gen. Pl. II (1891) 737=*Pritchardia lanigera* Becc.
. . . . *Martii* O. Kuntze, Rev. Gen. Pl. III, 2 (1898) 323=*Pritchardia Martii* H. Wendl.
. . . . *pacifica* O. Kuntze, Rev. Gen. Pl. II (1891) 737=*Pritchardia pacifica* Seem. et H. Wendl.
. . . . *remota* O. Kuntze, Rev. Gen. Pl. II (1891) 737=*Pritchardia remota* Becc.
. . . . *Thurstonii* O. Kuntze, Rev. Gen. Pl. II (1891) 737=*Pritchardia Thurstonii* F. Muell. et Drude.



DETAILED DESCRIPTION OF SPECIES.

1. **PRITCHARDIA PACIFICA** Seem. et H. Wendl. in Bonpl. IX (1861) 260 and X (1862), pp. 197, 310, t. 15; Seem. Fl. Vit. 274, t. LXXIX and in Viti, An Account, etc., 368; Kerchore, Les Palm. 331, t. XXVII; Rev. Hort. 1873, 329—1874, 65—1875, 35; Illustr. Hort. 1874, 27, t. 161—1881, 32; Belgique Hort. 1875, 62—1878, 114; Fl. des Serres et Jard. 1877, t. 2262; Becc. Malesia, III, 290, t. XXXVII, f. 13-15, and in Webbia, II (1907) 202, and IV (1913) 206, and 210; Drake del Cast. Ill. Fl. Ins. Pac. VII, 323; Blatter, Palms Brit. Ind. in Journ. Bomb. Nat. Hist. Soc., March 31, 1912, 358, pl. XXIX.

Corypha umbraculifera (non Linn.) Forst. Pl. escul. 49 et Prodr. 88 (in part) ex Seem. l. c.

Washingtonia pacifica O. Kuntze, Rev. Gen. Plant. II (1891) 737.

Eupritchardia pacifica O. Kuntze, Rev. Gen. Pl. III, 2 (1898) 323.

(Plate XXIV, *W*)

Description.—A fine rather large Palm. *Stem* 7-10 m. high, straight and about 30 cm. in diam. *Leaves* glabrous, or nearly so in every part (at least when fully developed); the blade one-third of a circle in outline, broadly cuneate at the base, and with a large central entire part; the median segments relatively short in the free part, about 30 cm. long and 4-4.5 cm. broad at the disjunction places, cleft at apex, to the extent of about 10 cm. into two very acuminate non-drooping points; the dry blade has a tough structure, is concolorous and dull on both surfaces; the lower surface is completely devoid of lepidia; transverse veinlets very minute and approximate; the dorsum of the costae is glabrous; petiole about as long as the blade (1-1.20 m. long), spreading-arched. *Spadices* shorter than the petioles, whole about 50 cm. long, composed of an ovate, rather dense, 20-25 cm. long panicle, carried upon an about as long or a little longer, terete, pubescent, peduncular part; the latter as thick as a man's little finger; the panicle is glabrous in every part, has the lower branches, 4-6-partite, and is simply branched above; floriferous branchlets slender, rigid, terete, 8-10 cm. long, about 2 mm. through at the base. *Spathes* not much shorter than the whole spadix, finely tomentose outside, tubular in their lower part, and dilated above, into a lanceolate acuminate blade. *Flowers* spirally inserted around the branchlets, each furnished with a very slender, capillary, bracteole, lanceolate before expansion, 7.5-8 mm. long, 3.5 mm. through; calyx, cyathiform-campanulate, somewhat contracted at the base (when dry), very obscurely veined, shortly 3-toothed; the staminal ring at the time of the anthesis protrudes considerably above the calyx; filaments subulate, spreading; anthers, sagittate-oblong slightly emarginate at apex; segments of the corolla, elongate-triangular, blunt, truncate at the base, finely striate outside; ovary turbinate, truncate and deeply sculptured above; style, trigonous, sulcate; segments of the corolla elongate-triangular, blunt, truncate at the base, finely striate outside. *Fruit* spherical, 11-12 mm. in diam., slightly excentrically terminated by the rather conspicuous remains of the abortive carpels and style; pericarp, 1.3 mm. thick. *Seed* spherical, 7 mm. in diam., the surface smooth, blackish. *Fruiting perianth* conspicuous, distinctly pedicelliform, terete, 4 mm. long, 3.5 mm. through.

Habitat.—The species of *Pritchardia* occurring in the Fiji Islands at Vanua Levu and at Viti Levu (Seemann No. 659 in the Herbarium at Kew—type specimen) must be considered the true *Pr. pacifica*. Native names "Viu," "Sakiki," or "Niu Masei." It is reported, however, to grow also in the Samoan Islands and in Eua, one of the islands of the Tonga or Friendly group.

The Samoan *Pritchardia* I have hitherto considered as representing a distinct variety of *Pr. pacifica*, but it is apparently a plant introduced into those Islands.

Of the *Pritchardia* from the Tonga Islands I have seen no specimens.

J. J. Lister in Hemsley on the "Flora of the Tonga and Friendly Islands" (Journ. Linn. Soc. Botany, vol. XXX, 1893, p. 162) says that in Eua, along the eastern shore, the "Piu" or "Biu Palms" (*Pritchardia pacifica*) with their great fan leaves, are very handsome objects. The trees are generally very high, running to about 60 to 80 feet (18 to 24 m.). In the same paper are mentioned also the Marquesas Islands as another locality for *Pr. pacifica*, a statement which I greatly doubt, considering the precinctivity of the different species of *Pritchardia*.

A *Pritchardia* from the Tonga Islands is mentioned also by J. H. Burkill in "The Flora of Vavau, One of the Tonga Islands" (Journ. Linn. Soc. Botany, vol. XXXV, 1901, p. 57) and is referred also to *Pr. pacifica*.

Observations.—I am indebted to Professor J. F. Rock for complete specimens of this palm derived from plants cultivated at Honolulu in the Hawaiian Islands; which specimens, as far as the flowers and fruits are concerned, correspond exactly to Seemann's No. 659 of the Kew Herbarium. The portion of the leaf which accompanies the flowers and fruits of Rock's specimen, shows no lepidia on the lower surface; whereas the leaf that I have described in Webbia IV (1913) 210 as that of *Pr. pacifica* had rather numerous elliptical appressed lepidia; but that leaf was from a plant cultivated at Herrenhausen, and there is no absolute certainty of its belonging to the true Fijian *Pritchardia pacifica*. It is possible, however, that the nature and quantity of the leaf-trichomes may vary according to the different conditions of environment and culture. I consider therefore as one of the main characteristics of *Pr. pacifica*, the quite glabrous leaf-blade, even on the dorsum of the main costae, and the absence of the lepidia on its lower surface. *Pr. pacifica* is also characterized by the spadices being shorter than the petioles, by the slender floriferous branchlets and by the small round fruit, and small fruiting perianth.

Pritchardia Pacifica var. *Samoensis* Becc. in Webbia IV (1913), 206 and 212.

Description.—Flowers smaller than in the Fijian plant; the fruit of the same dimensions but with a thicker pericarp.

Habitat.—The Samoan Islands (S. Powell in the Kew Herbarium) According to Rechinger (Botan. u. zool. Ergebnisse einer Wiss. Forschungsreise

n. den Samoa-Ins. etc. III, p. 63) no *Pritchardia* is found growing wild in Samoa and the specimens preserved in the Kew Herbarium must have been obtained from a cultivated plant.

2. **PRITCHARDIA THURSTONII** F. Muell. et Drude in Gartenflora, Sept. 1887, 486, ff. 123, 124, and in Garden Chr. Sept. 1887, 341; Becc. Malesia, III, 290, t. XXXVII, f. 1-12.

Washingtonia Thurstonii O. Kuntze, Rev. Gen. Pl. II (1891) 737.

Eupritchardia Thurstonii O. Kuntze, Rev. Gen. Pl. III (1898) 323.

Description.—A smaller plant than *Pr. pacifica*. *Stem* apparently 4-5 m. high, and about 15 cm. in diam. *Leaves*, glabrous in every part, at least when fully developed; blade one-third of a circle in outline, flabellate with a broadly cuneate base, parted to somewhat above the middle into numerous segments; thinly coriaceous, nearly glaucescent underneath from a very thin waxy coating, and also sprinkled with small elliptical lepidia, which nestle into small depressions of the epidermis; transverse veinlets immersed in the parenchyma and little visible; central segments 50 cm. long in the free part, and 4-4.5 cm. broad at the places of disjunction, from thence gradually acuminate to shortly bifid apices; the lower costæ are furnished with a few hyaline scales and are otherwise glabrous. Petioles apparently little shorter than the blade, 4 cm. broad at apex. *Spadices* several, springing from the crown, arched-nodding, longer than the leaves and up to 2 m. in length; they consist of a rather dense, relatively short ovate panicle, supported on a very long peduncular part, which is sheathed by several, very elongate spathes; rachis of the spadix terete, 8-12 mm. in diam. throughout; panicle about 30 cm. long, twice branched in its lower part (the lower and intermediate branches being 2-3-furcate) and simply branched above; floriferous branchlets slender, 10-15 cm. long, 2 mm. through, and minutely wrinkled when dry, though apparently rather fleshy when fresh. *Flowers* rather closely spirally arranged around the branchlets, each furnished with a minute bracteole, when full grown just before expansion, oblong, 6-7 mm. long; calyx cupular-campanulate, shortly 3-toothed; staminal ring (at the time of the anthesis) shortly protruding beyond the calyx; filaments subulate; anthers linear-oblong; corolla about twice as long as the calyx, its segments semiovate, 7-costulate; ovary depressed-turbinate, truncate, and strongly sculptured above; style subtrigonal, sulcate. *Fruit* globose, 7 mm. in diam., terminated, slightly excentrically, by the rather conspicuous remains of the abortive carpels and elongate style; the whole pericarp is not quite one millimeter thick. *Seed* spherical, 4 mm. in diam. *Fruiting perianth* pedicelliform, slightly campanulate, 3 mm. long and equally broad.

Habitat.—Discovered in the year 1886 by the late Hon. J. B. Thurston in one of the more eastern islands of the Fiji group.

Observations.—It is easily distinguishable from *Pr. pacifica* by its smaller dimensions; by the smaller flowers and fruits; by the slender spadices longer than the leaves. I have completed the description of this species given by me in Malesia (l. c.) availing myself of a good specimen preserved in the Berlin Herbarium, derived from a plant cultivated in the Demerara Botanic Garden in

British Guyana. From that specimen the leaves appear considerably different from those of *Pr. pacifica*, having longer, shortly bifid, drooping segments, and the lower surface slightly glaucous-waxy and sprinkled with minute lepidia; the latter nestling in small depressions of the epidermis.

3. **PRITCHARDIA MAIDENIANA** Becc. in Webbia, IV (1913) 213, f. 12.

Description.—Apparently of middling size. *Leaf blade* rigid, coriaceous, 90 cm. long from the ligula to apex, parted to past the middle into numerous segments; lower costæ, very densely tomentose; lower surface very slightly glaucescent-waxy and sprinkled with minute punctiform or oblong lepidia, which nestle into small depressions of the epidermis; transverse veinlets obsolete, being immersed in the parenchyma; central segments about 50 cm. long in the free part, and 4 cm. broad at their places of disjunction, deeply parted into two rigid, very gradually acuminate points. *Petiole* 4 cm. broad at apex, densely tomentose on the lower surface. *Spadices* glabrous in every part, very rigid, apparently considerably shorter than the leaves; spathes fugaceously cottony, finally glabrous, chartaceous; panicle broadly ovate, 20-23 cm. long, very rigid, composed of not many spreading branches, of which the lower are 3-4-partite, and the upper simple; the peduncular part of the panicle is strongly flattened, glabrous, 12-15 mm. broad, apparently not much longer than the panicle itself. *Floriferous branchlets* very rigid, thickish, 6-8 cm. long, 4-5 mm. through, subtorulose, carrying the flowers spirally and rather closely set all round and seated on conspicuous orbicular pulvinuli. *Flowers* furnished with a capillary bracteole 7-8 mm. long, of a very hard coriaceous structure, elongate-conical before expansion, 10-11 mm. long, 3.5-4 mm. through at the base, and narrowed above; calyx cupular, relatively short (3 mm. long) cylindrical with flat base, very slightly 3-toothed, obsoletely veined; corolla 3 times as long as the calyx; the segments lanceolate (always?), terminated by a callous papillose outwardly turned apiculum, obsoletely costulate outside; staminal ring protruding, shortly, beyond the calyx; filaments subulate, spreading; anthers linear-sagittate. *Ovary* obovate-turbinate, slightly sculptured above; style, 3-sulcate; stigmata punctiform. *Fruit*, small, spherical, or very slightly longer than broad, 12-14 mm. in diam., terminated, slightly excentrically, by the rather conspicuous remains of the abortive carpels, and of the elongate style; whole pericarp 1.5-2 mm. thick. *Seed*, spherical, about 9 mm. in diam. *Fruiting perianth* pedicelliform, terete, 4 mm. through, and 3 mm. high. ..

Habitat.—Cultivated in the botanical garden at Sydney, but of unknown origin; supposed, however, to be a native of some of the islands of oriental Polynesia. The species was described from complete specimens kindly forwarded by Mr. J. H. Maiden.

Observations.—A quite distinct species, especially characterized by its very coriaceous deeply parted leaf-blade, subglaucous-waxy and dotted with spaced minute lepidia beneath; by the short very rigid spadices, with not many thick torulose floriferous branchlets; by the small globose fruits; by the short calyx and relatively long corolla; and by the segments of the corolla being curiously apiculate-callous at apex, if this peculiarity is not an anomaly.

4. **PRITCHARDIA HILLEBRANDI** Becc. Malesia, III, 292 (excl. of the description of the leaves) t. XXXVIII, f. 4-10; and in Webbia, II (1907), 203, and IV, 218; Rock, Indig. Trees Haw. Isls. (1913), 103.

Washingtonia Hillebrandi O. Kuntze, Rev. Gen. Pl. II (1891) 737.

Eupritchardia Hillebrandi O. Kuntze, Rev. Gen. Pl. III, 2 (1898) 323.

Pr. Gaudichaudii (non H. Wendl.) Hillebr. Fl. Haw. Isls. (1888) 450 (in part).

(Plates II; A; XXIV, T)

Description.—Of medium size with a stem 6-7 m. high, and a fine crown of large leaves. *Leaf-blade* of a rather rigid and thickish structure, about 1.30 m. long from the ligula to apex, divided into about 60 segments, and having two-thirds of its central part entire, glaucescent from a thin powdery-waxy coating, and devoid of lepidia on the lower surface; the transverse veinlets are scarcely visible, being immersed in the parenchyma; central segments 6-7 cm. broad at their disjunction places, and deeply parted into two very gradually and very finely acuminate, rather stiff points. Petiole about as long as, or a little shorter, than the blade, 3.5-4 cm. broad at apex, very densely covered on the lower surface with a felted, ashy-silvery indumentum, of the appearance of amianthus, which extends also, profusely, on the dorsum of the lower costae. *Spadices* about as long, or even shorter than the petioles (60 cm. to 1 m. long) composed of 3 distinct loose panicles (always), the latter carried on a common rather slender peduncular part, spathes thinly chartaceous, more or less fugaceously covered with silvery wool, finally glabrous. The panicles are 20-30 cm. long, twice branched, at least in their lower part. Floriferous branchlets spreading, rigid, thickish, usually from 8-12 cm. long and 3-4 mm. through at the base, narrowed above, subterete-torulose, carry the flowers (seated on rather conspicuous orbicular pulvinuli) closely spirally arranged, nearly regularly, in 4 longitudinal series; at every flower is a capillary bracteole, 5-8 mm. long. Unopened flowers narrowly oblong and rather suddenly obtusely apiculate, 8-9 mm. long, 4 mm. through; calyx of a rather hard texture, and with a thicker, solid, almost woody base, cyathiform-cylindraceous, very shortly 3-toothed, the teeth not, or only obsoletely marked with convergent veins, otherwise smooth; corolla twice as long as the calyx, the segments oblong, obtusely apiculate, obsoletely 7-costulate outside, truncate and, shortly, 2-auricled at the base; staminal ring shortly protruding beyond the calyx; filaments subulate from a rather broad base, spreading; anthers oblong-linear-sagittate, blunt; ovary depressedly turbinate, deeply sculptured above, suddenly narrowed into a trigonous sulcate style; stigmata punctiform. *Fruit* globose, at times slightly longer than broad, 20-22 mm. long, 17-19 mm. through, with the remains of the sterile carpels and style exactly apical, and marked alongside by two very faint ridges descending from apex; it is at first yellowish or reddish brown and becomes intensely bluish, or nearly black, and with a polished surface at maturity. Whole pericarp 3 mm. thick; the mesocarp is grumous, traversed by a very few slender fibres, sweetish when ripe, and of a date-like taste; endocarp very thin, woody, brittle. *Seed* spherical, 11-13 mm. in diameter. *Fruiting perianth* pedicelliform, cylindrical, 4 mm. through and high.

Habitat.—The Hawaiian Islands. I had supposed that Hillebrand's specimens, upon which the species was founded, came from Molokai, but, as I have pointed out in "Malesia" (p. 294 in a foot-note), much confusion existed regarding Hillebrand's specimens of *Pritchardia*, and relative labels, in the Berlin Herbarium, and the real home of this species is as yet unknown.

Observation.—Hillebrand had incorporated in his *Pr. Gaudichaudii* several quite distinct species. One of these is the present (*Pr. Hillebrandi* Becc), which must be considered as established on the flowers and fruits described and figured by me in "Malesia" (l. c.). Up to the present time there was some uncertainty about the nature of the leaves, belonging to *Pr. Hillebrandi*, but now that Professor Rock has procured me numerous complete specimens of this palm, it has turned out to be one of the better known species of *Pritchardia*, easily distinguishable: by the leaf-blade having the lower surface devoid of lepidia and rendered conspicuously glaucescent by a thin waxy-pulverulent coating; by the petiole being densely woolly on the lower surface, the woolliness extending over the lower main costae; by the glabrous spadices; and by the medium-sized globular fruit carried on a distinct, cylindrical, pedicelliform fruiting perianth. *Pr. Hillebrandi* varies a little in the degree of branching of the flowering panicle, and slightly in the size of the fruit.

In a plant growing in Mr. Young's Kapiolani Park in Honolulu (Rock n^o. 12007) undoubtedly referable to *Pr. Hillebrandi*, (the lower surface of the blade being conspicuously glaucous-waxy) the spadix is divided, according to a note of the collector, into 3 distinct panicles—a character visible also in a photograph of that plant, and apparently constant in *Pr. Hillebrandi*.

NOTE BY JOSEPH F. ROCK.

A very robust form of this species with large leaves and petioles measuring 1.50 m. in length and a stiff erect spadix nearly 2 m. long which branches into five distinct panicles, is cultivated on the island of Molokai on the lee-side near Kamalo and in various other places from Kaluaaha toward Halawa. The very robust habit of this plant which differs in several respects from the typical form but only in size and not in shape of seed or flower, might be recognized as a distinct form under the name forma *robusta*, f. n. The fruits are also larger than those of the typical form. The robust size of this plant may, however, be due to the splendid and rich soil in that locality. I have been so far unable to find the typical *Pritchardia Hillebrandi* in a wild state on any of the islands of the Hawaiian group, and so far it is only known from cultivated specimens. On a recent journey in remote regions on Molokai, I was informed by natives that it grew near the sea in Pelekunu Valley, and as it is extensively cultivated on Molokai I presume that it is actually a native of that island. I was unable to verify the statement made by the natives on account of the impassable condition of the mountain pass leading into that valley and the time of the year, which prohibited the landing of any vessel.

5. *PRITCHARDIA INSIGNIS* Becc. in Webbia, IV (1913) 219, f. 13.

Description.—Apparently one of the largest. *Leaf-blade* 1.30 m. long from the ligula to the apex (in one specimen), entire in its central part to above the middle, and parted into about 60 segments; it is of a rather rigid, thickish structure, sub-glaucous and slightly pulverulent-waxy, and devoid of lepidia on the lower surface, the transverse veinlets are almost obsolete, being immersed into the parenchyma; rachis and lower main costae at first tomentose, but finally almost glabrous. Segments rather stiff, and apparently with not drooping apices, parted to the extent of 15-25 cm. into two very gradually finely acuminate points; the central segments 5-5.5 cm. broad at their disjunction places. Petiole longer than the blade, 4.5 cm. broad at apex, quite glabrous on both faces, slight pulverulent-waxy above; ligula short, crescent-like. *Spadices* apparently shorter than the petioles, rigid, 60 cm. long (in one specimen); spathes thinly chartaceous, more or less fugaceously covered with a silvery wool, finally glabrous; the panicle is about 20 cm. long, with the lower branches 2-4-parted, simply branched above; floriferous branchlets very rigid, erect-spreading, glabrous, have a polished, and not wrinkled surface, even when dry, are thickish, slightly sinuous, subterete, 8-12 cm. long, 4-5 mm. through at the base, narrowed towards the end, covered all around, spirally and rather closely with flowers; the latter seated on orbicular pulvinuli, each of which is furnished with a 3-5 mm. long capillary bracteole. *Flowers* of a very hard structure, when fully developed yet still unopened, 10-11 mm. long, 4 mm. through at the base, and attenuate above; calyx cyathiform-cylindrical with a flat base, 5 mm. high, relatively thinly coriaceous, and with a somewhat thickened base, smooth outside (not veined), very faintly 3-toothed; corolla about twice as long as the calyx, obsoletely 3-gonous and rather acute at apex, the segments elongate-triangular, not, or only obsoletely veined outside; staminal ring shortly protruding beyond the calyx; the filaments outwardly curved soon after the anthesis; anthers linear-sagittate. Ovary ovoid, sculptured above, gradually narrowed into a rather short, thickish, trigonous, sulcate style; stigma punctiform. *Fruit* spherical, 14-16 mm. in diameter, with the rather conspicuous remains of the sterile carpels, and style exactly apical. Whole pericarp 2 mm. thick; mesocarp grumous. *Seed* 10-12 mm. in diameter. *Fruiting perianth* pedicelliform, subcampanulate, slightly broader than high, the remains of the filaments recurved.

Habitat.—The specimens from which the above description was drawn up were derived from a plant cultivated in the Demerara Botanic Garden at Georgetown in British Guiana and which certainly was of Polynesian, or possibly even of Hawaiian origin. (n°. 7970 and 8800 in the British Guiana Herbarium.)

Observations.—*Pr. insignis* comes near to *Pr. Hillebrandi*, which it greatly resembles in the leaves, which are powdery-waxy and devoid of lepidia on the lower surface, but is distinguishable by its glabrous petioles, by the panicle being less branched, with thicker floriferous polished, terete branchlets, and by its smaller fruits. (N. B.—The fruits represented in Webbia IV, 220 f. 13 are one-tenth smaller than natural size.)

A specimen, in flower, of this *Pritchardia*, n°. 7970 in the Berlin Herbarium, is accompanied by the following note: "Length of petiole 7 ft. 9 in. (2.36 m.), width of leaf 3 ft. 9 in. (1.34 m). Spadix 1 ft. 6 in. (45.6 cm.), erect."

6. **PRITCHARDIA REMOTA** Becc. Malesia, III, 294 and in Webbia, II (1907) 203, and IV, 222; Rock, Ind. Trees Haw. Isls. (1913) 103.

Pr. Gaudichaudii (non H. Wendl.) Hillebr. Fl. Haw. Isl. 450 (in part).

Washingtonia remota O. Kuntze, Rev. Gen. Pl. II (1891) 737.

Eupritchardia remota O. Kuntze, Rev. Gen. Pl. III, 2. (1898) 323.

(Plates II, B; XXIII, O; fig. 1, IV)

Description.—One of the smallest species of the Genus, 4-5 m. high. *Stem* slender, flexuous, closely ringed, about 15 cm. in diameter; the crown of leaves rather dense and somewhat ruffled. The *leaf blade* measures about 80 cm. from the ligula to the apex, and has a relatively small central undivided part, is chartaceous, concolor on both surfaces, very slightly pulverulent-waxy, especially underneath, where it is also very sparingly besprinkled with very minute punctiform, almost rudimentary microlepidia; all segments are very long and narrow, longer than the central undivided part of the blade, and very deeply divided into two very gradually acuminate points, which end in very long capillary apices; in every sinus is a long filament; the central segments are 3 cm. broad at their disjunction places; the costae are covered with a fugaceous woolliness. Petioles apparently shorter than the blade, 2-2.5 cm. broad, glabrous on both sides, ligula short, rounded. *Spadices* apparently shorter than the leaves, have a peduncular subterete part, about 15 mm. through; the panicle is apparently longer than the peduncular part, rather large, 30 cm. long, glabrous in every part, spreadingly divided into several primary branches, the lowest of which are 15-20 cm. long, and carry spirally, at different heights, as many as 10-12 floriferous branchlets, the lowest of which, at times, divide again, or are forked; in its upper part only the panicle is simply branched. Floriferous branchlets slender, 10-12 cm. long, 2 mm. through at the base and subulate at apex; they carry the flowers, not very crowded, spirally all around, seated on small orbicular convex pulvinuli, each of which is furnished with a very small, 2-3 mm. long bracteole. *Flowers* (unopened) oblong, with a nearly rounded obtusely apiculate top, 8-9 mm. long, 4 mm. through; calyx cyathiform-campanulate, with 3 low but rather acute teeth, thickly coriaceous and smooth in its lower part, and sharply marked (in the dry condition) near the mouth with a thinner finely veined rim; corolla twice as long as the calyx, the segments oblong, strongly and closely striately veined, or rather pluricostulate externally; staminal ring slightly protruding beyond the calyx; filaments subulate from rather broad bases; anthers linear-sagittate; ovary obovoid-turbinate, strongly sculptured above, conically narrowed above into a rather short, thickish, trigonous, sulcate style; stigma punctiform. *Fruit* globose-ovoid, or very slightly longer than broad, 19-20 mm. long, 18-19 mm. through, with the remains of the abortive carpels and style exactly apical, and marked along side by two very faint ridges, descending from apex; whole pericarp about 2 mm. thick; the mesocarp slightly parenchymatous accompanied by several fine fibres; endocarp thinly woody, brittle. *Seed* globular, slightly flattened on the raphe side. *Fruiting perianth* pedicelliform, terete-ventricose, 4 mm. high and through. The apparently nearly completely mature fruit is of a light greenish-brown color and has a polished surface, otherwise it is very similar to that of *P. Hillebrandi*.

Habitat.—Bird Island or "Nihoa," one of the most northerly islands of the Hawaiian group. Professor Rock procured me the specimens, from which the description above is drawn up; they were collected by Capt. Brown of the U. S. Revenue cutter "Thetis." The specimens were accompanied by a photograph, from which are deduced the general characteristics of the plant.

Observations.—It approaches *Pr. Hillebrandi* more than any other. It is, however, a distinct species, characterized by its small dimensions and slender trunk; by the leaf blade being deeply parted into long and narrow segments, filamentose at apex, minutely powdery-waxy on the lower surface, and very sparingly sprinkled with almost rudimentary punctiform microlepidia; by the rather large, much branched panicle; by the oblong blunt flowers, having the calyx distinctly rimmed, and the segments of the corolla strongly striate-pluricos-tulate; by the globose rather small shiny fruit, carried on a rather conspicuous pedicelliform, terete-ventricose, fruiting perianth.

7. PRITCHARDIA AFFINIS Becc. sp. n.

(Plates III, *A, B*; XXII, *K*)

Subelata. Foliorum lamina utrinque virentia necsubtus cerco-pulverulenta, segmentorum lacinis valde elongatis, apicibus tenuissimis flaccidis. Ramuli floriferi graciles, inter flores zig-zag sinuosi fructiferi rigidi, subtorulosi, basi circiter 3 mm. crassi, 8-12 mm. longi. Flores acuminati, 9-11 mm. longi, calyce cyathiformi-campanulato coriaceo, inferne intus solido et sublig-noso, breviter 3-dentato, ad dentes venoso; corolla calyce subduplo longiori, petalis extus haud profunde striatis. Fructus mediocris, maturus atro-violaceous, nitidus globosus vel basi paullo attenuatus et globoso sub-clavatus, 20-25 mm. longus, 16-23 mm. diam. Perianthium fructiferum pedicelliforme, cylindraceum vel levissime campanulatum.

Description. Rather tall, approximately 10 m. (—25 m. in height with a beautiful crown (Rock). *Leaves* large; the blade is deeply parted into numerous segments and measures from the ligula to the apex about 1 m.; the mid-costae, especially the lower ones, are clothed, at least in recently developed leaves, with a dense, light-colored or pinkish soft wool. The segments are not very stiff; have their upper part drooping; are very deeply parted into two long, finely acuminate points, filamentous at the apex; both surfaces very finely striated by numerous tertiary nerves, and the transverse veinlets rather sharp; the upper surface quite glabrous; the lower slightly paler but not glaucescent nor powdery-waxy, and distinctly dotted with numerous minute, yellowish, orbicular, or oblong, non-fringed lepidia. Between the segments is a long conspicuous filament; the central and largest segments are 4 cm. broad at their disjunction places. *Spadices* glabrous in every part, apparently composed of one panicle only, carried on a rather robust peduncular part; secondary branches radiately divided into 4-10 floriferous branch-lets; the latter are 5-8 cm. long rather narrow, angular (at least when dry, and, at the time of the anthesis, zigzag sinuous between the flowers; bracts at the base of the pulvinuli very fine, deciduous. *Flowers* (unopened) somewhat lanceolate in outline, acute, or even acuminate, 9-11 mm. long, 4-4.5 mm. through; calyx

cyathiform-campanulate, solid and callous at the base, very shallowly 3-toothed, with rather prominent nerves convergent to the apices of the teeth; corolla two and a half times as long as the calyx, obsoletely trigonous; petals inserted a little above the middle of the tube, subtriangular acute or apiculate, not deeply striate outside, the base truncate with rounded (not auricled) sides; staminal ring not, or only slightly protruding beyond the calyx, the filaments erect even after the anthesis; anthers lanceolate, bluntish or obsoletely emarginate. Ovary turbinate, deeply sculptured above; style elongate—conical, sulcate, reaching with its punctiform stigma about to the middle of the anthers. Fruit spherical, occasionally narrowed to the base, 23 mm. in diameter; the whole pericarp is 3 mm. thick; mesocarp grumous; endocarp one-half mm. thick. Fruiting perianth pedicelliform, slightly campanulate-subcylindrical, 3 mm. high and 4 mm. through.

Habitat.—The Hawaiian Islands. Near Kealia, in the lower forests of South Kona in Hawaii, elev. about 600 m. (Rock No. 12796. Typical but somewhat fragmentary specimen).

Observations.—It approaches *Pr. Hillebrandi* in the flowers and fruit, but it is easily distinguishable from it by the different appearance of the lower surface of the blade, which in *Pr. affinis* is dotted with small, yellowish, orbicular, oblong unfringed lepidia, whereas in *Pr. Hillebrandi* it is glaucous from a thin coating of pulverulent wax, and has no lepidia; the fruit is also a little larger than in *Pr. Hillebrandi*.

To *Pr. affinis* are referable several individuals cultivated in Honolulu, the fruits of which, as Professor Rock learned from old people, were brought from Kona. A fine specimen of what I consider as typical *Pr. affinis*, and of which Professor Rock has procured me a good photograph, is growing in the garden of Mr G. J. Ballentyne, 1559 Thurston Street (Rock No. 12003). In this specimen the leaves have a robust petiole, about 4 cm. broad at apex, tomentose on the lower surface; the ligula is oblong. The spadices appear a little shorter than the petioles, perhaps 70-80 cm. long, and have one panicle only, at the end of a rather robust peduncular part, which, when sheathed by the spathes, is about 3 cm. through; the spathes are chartaceous, and more or less temporarily covered with silvery wool. The fructiferous branchlets are thickish (3 mm. through) 8-10 cm. long, angular, torulose and closely zigzag, sinuous between the rather projecting flower-pulvinuli. Fruit exactly as described above. Quite similar to the preceding is another plant, cultivated also in Honolulu, in the garden of Mrs. Gus. Schuman, 1448 Keeaumoku Street (Rock No. 1200).

On the whole, *Pr. affinis* seems to be a variable plant, especially in size, shape of fruit, thickness of the branchlets, and number of lepidia on the lower surface of the leaf-blade, the latter occasionally being even quite absent in var. *gracilis*. Of it we may distinguish the following not sharply defined varieties.

NOTE BY JOSEPH F. ROCK.

The typical *Pritchardia affinis* Becc. grows wild on the southern slopes of Mauna Loa, in South Kona, and is not uncommon at a place called Kaohe and

Opihale, where I measured a specimen 75 feet tall; others were observed 50-75 feet (20-25 m.) in height. The usual size is about 10 m. or even less, especially of the cultivated specimens in Honolulu and on Hawaii. The three palms here reproduced grow at Kaohe in South Kona, the taller specimen mentioned above could not be photographed on account of the brush and trees which did not permit me to get far enough away to get the whole palm on the plate.

Additional specimens were collected at Kaohe, South Kona, Hawaii, in March, 1920, Rock No. 17347 in the College of Hawaii Herbarium.

Pritchardia affinis var. *Holaphila* Becc.

(Plate IV, A.)

Description.—Rather small, 3-5 m. in height. Stem 20-24 cm. in diameter. *Leaves* as in type, dotted underneath with very spaced, minute, suborbicular lepidia. The *spadix*, whole, 80 cm. long, and with one panicle only; the latter about 24 cm. long, twice branched in its lower part and simply above. Floriferous branchlets 7-10 cm. long, and 1.5-2 mm. through (when dry) at the time of anthesis, subangular and slightly zigzag sinuous between the flowers; thicker when carrying the fruits (3-3.5 mm. through) and terete-subtorulose. Spathes covered as usual with silvery wool. *Flowers* a little smaller than in type, with the staminal ring slightly protruding above the calyx. *Fruit* spherical, not slightly narrowed to the base, 20-21 mm. in diameter; otherwise it does not differ from that of the type; when thoroughly mature it is black, has a polished surface, and the mesocarp apparently contains sugar.

Habitat.—Of this palm Professor Rock says that it was collected at Kalapana in the district of Puna, the easternmost point of the Island of Hawaii. It grew among rocks together with *Pandanus* and *Cocos nucifera*, near the sea, in exceedingly dry situations, where the air is saturated with salt spray from the sea, producing a thick haze (Rock No. 12795 in Herb. Becc.).

Observations.—It differs from the type only in its smaller dimensions and in the slightly smaller flowers, having the staminal ring a little more protruding beyond the calyx. The environmental conditions are probably the cause of its smaller stature and of the other trifling peculiarities.

***Pritchardia affinis* var. *rhopalocarpa* Becc.**

(Plates IV, B; XXII, L)

Description.—It attains a considerable height and has a slender stem. *Leaves* as in type; segments with drooping, very long filamentose apices; their lower surfaces paler than the upper, not pulverulent-waxy, and dotted with very few small, punctiform lepidia. *Petiole* 3.5 cm. broad at apex; ligula oblong rounded at apex, base of the blade and mid-costas strongly woolly, especially on the lower surface. Fructiferous branchlets subterete with subulate apices. Young and half mature *fruits* are obovate-clavate, being, in that period of growth distinctly narrowed to the base; the thoroughly mature fruits, however, are globose oblong, or slightly longer than broad and not narrowed to the base, 25 mm. long, 20-22 mm. through, of a shiny virescent black color. Apparently in the last stage of maturity, the mesocarp thickens at the base more than elsewhere, so as to render obsolete the general obovoid shape of the young fruit; the mesocarp of the mature fruit is slightly bluish, and has a sweet taste. *Fruiting perianth* as in type.

Habitat.—The type specimens of this variety were gathered on the Island of Hawaii, from a plant which was growing on the seashore of South Kona at a place called Napoopoo, near the native temple where the English Captain Cook, who discovered the group of the Hawaiian Islands, was murdered (Rock No. 12779). Others of Rock's typical specimens bear the No. 12780, and come from a grove of palms situated at an elevation of several hundred up to 1000 feet, in Kona, above Kilauea, also in Hawaii.

Observations.—Rock remarks that this variety is very frequently cultivated in Honolulu, and that it is quite likely its seeds were sent there from Kona, where these palms are quite numerous; and I think the specimens of a palm (Rock No. 12001) growing in Mrs. W. Lanz's premises on Punahou street (Honolulu) are referable to it; of this Professor Rock has sent me a fine photograph, showing spadices about as long, or only a little shorter, than the petioles and composed of three superposed partial inflorescences. To the same variety belongs also a plant growing at Queen Liliuokalani's residence at Waikiki (Rock No. 12006). The specimens have immature fruits which are distinctly clavate-oblong.

It seems to me difficult to separate sharply *Pr. affinis* var. *rhopalocarpa* from the type. The wild specimens of the variety differ, however, from the typical *Pr. affinis* in the leaves having very few and very small lepidia on the lower surface, and in the more or less obovoid, or subclavate fruit. I am not certain if the typical *Pr. affinis* has the spadix composed of 3 partial inflorescences, as seems to be the normal case with the variety.

***Pritchardia affinis* var. *gracilis* Becc.**

Description.—A rather small palm, only 3-4 m. high. *Leaves* smaller, otherwise as in type, but devoid of lepidia on the lower surface; the costæ are

slightly woolly; but for them the lower surface is quite glabrous, slightly paler than the upper, and not powdery-waxy; ligula triangular, acute; spathes nearly glabrous. *Flowers* a little smaller than in type, 7 mm. long, 3 mm. through; staminal ring not protruding above the calyx. Floriferous branchlets 5-7 cm. long. The not thoroughly mature *fruits* are obovate, distinctly narrowed to the base, 20-22 mm. long, 16-17 mm. through.

Habitat.—Professor Rock's field note to this palm runs thus: "This rather small palm comes from the driest district of the Island of Hawaii. It grows among lava rocks by the sea in North Kona at Kiholo, it has small leaves and a short trunk, the palms being about 10-12 feet in height. The plants are exceedingly old, as was testified by some of the natives. Kiholo is considered one of the driest regions of Hawaii, with a rainfall of only a few inches a year." (Rock No. 12797 in Herb. Becc.)

Observations.—The immature fruits are exactly like those of equal degree of maturity of var. *rhopalocarpa* and really it may be considered as a subvariety of the latter. Its smaller stature may be set down to the less favorable conditions of its environment, in comparison with those plants, which are living in less exposed situations and in richer soil in the cooler and more humid forests of the mountain slopes. The lack of lepidia may be considered also as a consequence of the climate.

8. *PRITCHARDIA LANAIENSIS* Becc. et Rock, sp. n.

(Plates V, A; XXIV, V)

Subhumilis. *Folia ampla, utrinque virentia, subtus lepidiis minutis punctiformibus vel angustissime linearibus ferrugineis crebriusculè conspersa. Ramuli floriferi graciles. Flores fere regulariter bifarie alterni, cum inaperti angusti, calyce coriaceo-subcarnoso campanulato venoso, basi nonnihil attenuato, ibique vix calloso, petalis striato-costulatis. Fructus exacte sphaericus, 2 cm. diam. Perianthium fructiferum non pedicelliforme fere explanatum.*

Description.—Apparently very similar in general aspect to *Pr. Hillebrandi* but perhaps of smaller stature. *Leaf blade* thinly coriaceous or thickly chartaceous, up to 1.20 m. long from the ligula to apex, entire to about the middle in its central part, almost equally green on both surfaces, but closely spotted underneath with small, unequal, punctiform, or very narrowly-linear, rusty lepidia; central segments 4 cm. broad at their disjunction, parted into two very gradually acuminate rather stiff points; the lateral segments narrower, more deeply parted, and with slender, longer, and apparently drooping points. *Petiole* about 3.5 cm. broad at apex, covered, on the lower surface with a felted light-colored and pinkish wool, which also extends profusely on the dorsum of the lower costae, and in a minor degree to the upper ones. Entire *spadix* not seen by me (composed of only one or more inflorescences?); the inflorescences at hand have a peduncular part as thick as a man's little finger when sheathed by the bases of the spathes; the latter (3-5) are imbricate, tubular in their lower part and suddenly expand into deeply concave ass's ear-like, rigid, chartaceous, very soon glabrous, shortly

acuminate blades. The flowering panicle is about 20 cm. long, rather densely twice branched in its lower part, and simply above. Floriferous branchlets glabrous, spreading, very slender (1 mm. through, or thereabouts), zigzag sinuous between the flowers. Floral bracteoles extremely fine, setiform. *Flowers* not quite regularly alternate-bifarious; just before expansion are linear-oblong, rather suddenly, and obtusely apiculate, 8 mm. long, 2.5-3 mm. through; calyx of a subfleshy-coriaceous texture, campanulate, very slightly thickened at the base, very minutely 3-toothed, distinctly marked by several veins converging to the teeth; corolla two and a half times as long as the calyx, the segments broadly linear, rather strongly striate-costulate externally; staminal ring rather considerably produced above the calyx; filaments very slender and relatively long, spreading or arched at the time of anthesis; anthers lanceolate-sagittate, bluntish; ovary turbinate, sculptured above, and narrowed into a trigonous sulcate style; stigmas punctiform. The full grown yet not thoroughly mature fruit is exactly spherical, 2 cm. in diameter, centrally topped by the small remains of the sterile carpels and style; the surface is very minutely uneven, and of a rather dull hazelnut color. Pericarp (of the mature fruit) hard, not quite 2 mm. thick, grumous with very few fibers. *Fruiting perianth* nearly explanate (non pedicelliform) the calyx being callous but depressed.

Habitat.—The Island of Lanai, one of the smaller forested Islands of the Hawaiian group. Professor Rock, to whom I am indebted for the specimens from which the above description is derived, writes to me that this palm "grows at the head of the enormous and deep gorge known as Maunalei, at an elevation of 550-660 m. I saw plants of it often, but as they grow on inaccessible cliffs it was impossible for me to collect them and Mr. George Munro, manager of the Lanai Ranch Co., secured the specimens for me."

Observations.—There are no striking diagnostic characters for distinguishing at once this species from the allied species, and especially from *Pr. affinis*, which it resembles in general habit. It is, however, well characterized by the leaf blade being almost equally green on both surfaces, but closely spotted underneath by minute punctiform or linear, rusty lepidia; by the very slender floriferous branchlets with nearly bifarious flowers; by the narrow unexpanded flowers; by the calyx campanulate, veined, fleshy coriaceous, not, or but very slightly thickened at the base; by the striate-subcostulate petals, and especially by the quite spherical, rather small fruit, carried on a nearly explanate (non pedicelliform) perianth.

9. PRITCHARDIA GLABRATA Becc. et Rock, sp. n.

Inter minores. Foliorum lamina utrinque virens et glabra, subtus autem lepidiis parvis, orbicularibus, hyalinis, non fimbriatis conspersa, in parte centrali circiter 65 cm. longa et fere usque ad mediam integra; segmentis acute minute, crebreque venoso-striatis, majoribus ad basin 3 cm. latis. Spadix gracilis, spathis chartaceis, elongato-lanceolatis, fissilibus, demum glabris; panicula densiuscule ramosa, ramulis floriferis glabris, gracilibus. Flores spiraliter

alterni et in extremitate ramulorum subdistici, parvi, acuminati, calyce campanulato venoso, basi carnosio. Fructus parvus. Perianthium fructiferum subdepressum, calyce calloso.

Description.—One of the smallest, if not actually the smallest species, as far as can be guessed from the fragmentary specimens seen by me. *Leaf blade* about 65 cm. in length from the ligula to the apex, undivided to about the middle in its central part, and with the periphery cut into about 50 segments, chartaceous, equally green, and closely striated by sharp secondary and tertiary nerves on both surfaces; the lower surface dotted, rather closely, with orbicular very minute, not fringed, hyaline lepidia; the central and largest segments 3 cm. broad at their disjunction places, and divided into two gradually acuminate elongate points; the costae have been apparently slightly cottony in the newly expanded leaves, but are later glabrous on both surfaces. *Petiole* glabrous, shorter than the blade, (40 cm. long and 2 cm. broad at apex in one specimen). *Spadix* slender, 50-55 cm. long and with one panicle only (the specimen at hand is entire); spathes ass's ear-like, acuminate, chartaceous, fissile, very fugaceously slightly floccose; the flowering panicle is about 15 cm. long, rather densely twice branched in its lower part, and simply above; floriferous branchlets glabrous, slender 5-7 cm. long, about 1 mm. through (about 2 mm. at the fruiting time) slightly sinuous between the flowers. *Floral bracteoles* extremely fine, setiform, soon deciduous. *Flowers* spirally alternate in the lower part of the branchlets, nearly bifarious above; before expansion they are lanceolate in general outline and acuminate, 7 mm. long, 3 mm. through; calyx of a subfleshy-coriaceous structure, campanulate, somewhat thickened at the base, very minutely 3-toothed, distinctly marked (when dry) by several veins converging to the teeth; corolla twice as long as the calyx; the segments narrowly triangular, acuminate, very sharply striately-veined outside; staminal ring, at the anthesis time, produced considerably above the calyx; filaments extremely fine, deciduous after anthesis; anthers narrowly lanceolate-sagittate, bluntish; ovary turbinate, sculptured above and narrowed into a rather elongate trigonous sulcate style; stigmata punctiform. *Fruit* apparently small, but not seen mature; in the early period of development is ovoid-elliptical and not quite 1 cm. long. The *fruiting perianth* has a rather thickened callous calyx and the remains of the corolla tube and annular ring spreading.

Habitat.—The Hawaiian Islands. Professor Rock sent me recently (July 1918) the specimen of this small *Pritchardia*, collected in the Valley of Iao in the west part of the Island of Maui, where it was growing on the steep cliffs near the entrance of the broad valley, on the right side, at an elevation of 550 m. or less (Rock n^o. 14077).

Observations.—It is perhaps the smallest of all known *Pritchardias*, very characteristic on account of its small and quite glabrous leaves, green, sharply and finely striately secondary and tertiary nerves on both surfaces, having the lower surface dotted with small orbicular hyaline lepidia, visible only by the aid of a lens. The spadix is also glabrous; the panicle rather densely branched; the floriferous branchlets slender; the unopened flowers acuminate; the calyx campanulate sharply veined; the petals also sharply striate. The fruit is certainly small and

when young ovoid; the fruiting perianth can barely be termed pedicelliform as it appears somewhat depressed, with the calyx callous, and the corolla tube and staminal ring spreading.

10. **PRITCHARDIA MACROCARPA** Linden in Revue Hort. 1876, 375 (name only) and 1878, 186; Andre in Illustr. Hort. 1879 105; t. 352 et 1881, 32; Belgique Hort. 1883, 134. *Pritchardia Martii* (non H. Wendl.) Hillebr. Fl. Haw. Isl. 490 (in part); Becc. in Webbia IV. 223, f. 14.

(Plates XII, *A, B*; XXI, *F*)

Description.—A rather low palm with a somewhat bottle-shaped stem and large green leaves. The *leaf blade* measures 9-10-1.15 m. from the ligula to the apex along the central line, is cut to below the middle, at the sides, and to its upper third part in the center, into numerous segments, which are nearly flat (not much folded) and deeply parted into two very finely acuminate, somewhat drooping points; are green on both surfaces, but dotted underneath, rather closely, with very minute, orbicular, or elliptical, light colored, not fringed lepidia; transverse veinlets sharp, very slender and extremely approximate; the central, largest, segments are 4.5-5 cm. broad at their disjunction places. Petiole about as long or even longer than the blade, about 3 cm. broad at apex, glabrous above, more or less permanently woolly tomentose underneath, the tomentum extending to the base of the blade, especially on the dorsum of the costae. Ligula short, crescent like, shortly apiculate. *Spadices* elongate, as long as or longer than the petioles, composed of 2-3 partial inflorescences or distinct panicles, each of which is carried on a long peduncular part. The fruiting spadix is arched-nodding. Spathes more or less furnished with silvery fugaceous paleae. Panicles twice loosely branched in their lower part, simply branched above; floriferous branchlets glabrous, 10-12 cm. long or less, 2 mm. through at the base, somewhat angular (dry) and strongly sinuous between the spirally alternate flowers; every flower is furnished with a long setaceous, deciduous bracteole. *Flowers* (unopened) 9-11 mm. long, 4 mm. through, somewhat acuminate, subtrigonus, and often slightly asymmetrical; calyx campanulate, distinctly narrowed to the base, conspicuously striately veined (dry), the veins converging to 3 rather acute teeth; corolla usually somewhat more than twice as long as the calyx, its segments lanceolate acuminate and strongly striately veined; staminal ring slightly protruding above the calyx; filaments spreading, subulate from a broad base; anthers linear-sagitate, blunt; ovary turbinate, sculptured above and narrowed into a trigonous, sulcate, thickish style; stigma punctiform. *Fruit* very regularly obovate, rounded above and centrally apiculate, tipped by the small remains of the abortive carpels, narrowed from about the middle to a rather acute base, 4-4.5 cm. long, 3-3.5 cm. through, of a dull brown color in the dry state; whole dry pericarp 4-4.5 mm. thick; mesocarp grumous and permeated by few, very fine, longitudinal fibers, especially in its inner part; endocarp woody, 1 mm. thick all around but with a thicker broadly obconical base; the endocarpal cavity polished and white. *Seed* globose-ovate, about 2.5 cm. through, exactly erect; the hilum basal, orbicular, 15 mm. in diam. Embryo places a little above the base. *Fruiting perianth* relatively small, and depressedly pedicelliform, 4 mm. broad and 3 mm. high, having

the remains of the tube of the corolla and of the staminal ring, short, and inconspicuous.

Habitat.—This is certainly the *Pritchardia* which Hillebrand believed to correspond to Gaudichaud's *Livistona Martii*, and which he collected on Oahu; and probably to it belongs a specimen with flowers in his herbarium in Berlin, bearing on the label the note: "Palolo, Oahu (large seed) Hillebr. March 1870." But it is not unlikely that now *P. macrocarpa* has disappeared as a wild growing plant, owing to the great changes which occurred in recent times in the vicinity of Honolulu. Professor Rock, who has very assiduously explored the country around Honolulu, informs me that he has never found this palm in a wild condition, but that a number of these trees are cultivated in Honolulu, and he has actually procured me complete specimens of leaves, flowers, and fruits from one plant (No. 12763 and 14076) growing in the yard of Dr. Hillebrand's old residence in Honolulu. It is therefore obvious that *P. macrocarpa* was one of the species known to Hillebrand and probably the author of the "Flora of the Hawaiian Islands" (published in 1888) is speaking of it when he writes, under the heading of *P. Martii*: "In Nuuanu (one of the valleys a few miles west of Honolulu) until recent times two clumps could be seen from the upper part of the valley, one was completely exterminated when the natives found that the trees were valuable to amateurs of gardening in Honolulu, the other owes its preservation to the absolute inaccessibility of the cliff on which it stands."

It is not surprising that this palm has been introduced by Linden into Europe, it being easy to obtain its fruits from the individuals cultivated in Honolulu.

Observations.—I have accepted the name of *P. macrocarpa* for this fine palm, although no description of it has hitherto been given, except of its fruit, which was said to be of the size of a walnut. The woodcut, however, in the "Illustration Horticole," reproduces a young sterile plant, which agrees pretty well with a photograph (transmitted to me by Professor Rock) of the specimen growing in Dr. Hillebrand's old grounds. This specimen, producing bunches of large fruits, must be considered as the type of *Pr. macrocarpa* as understood by me. Probably in several gardens *Pr. macrocarpa* is reckoned erroneously as the true *P. Martii*, but the type specimen of the latter preserved in the Herbarium Webb at Florence, shows the lower surface of the leaves clothed with the peculiar coating of which I have given a figure in "Webbia," III. t. XXXVIII. f. 15, whereas in *Pr. macrocarpa* that surface looks glabrous; in fact, it is minutely dotted with small inconspicuous lepidia.

In Hillebrand's description of his *Pr. Martii* (which as to the fruit corresponds to *P. macrocarpa*) the leaves are said to be glaucescent below, but that is the main characteristic of *Pr. Hillebrandi*, and it also shows how confused the

material was from which Hillebrand derived the descriptions of *Pr. Martii* and *Pr. Gaudichaudii*.

Before I had seen the leaves, I believed *Pr. macrocarpa* to correspond to *P. Martii*, and under this name the fruit of *P. macrocarpa* was figured in *Webbia* (IV p. 224 f. 14); but now that Prof. Rock has re-discovered the true *Pr. Martii*, as well as *Pr. Gaudichaudii*, there is no more uncertainty about these two palms, and *Pr. macrocarpa* proves to be a species distinct from both, somewhat allied, however, to *Pr. Martii*. *Pr. macrocarpa* is well characterized by its small stature, and relatively stout stem; by its large leaves having long petioles and the blade apparently glabrous and green underneath, but dotted, rather closely with appressed, small, orbicular or elliptical, light colored not fringed, microlepidia; it is distinguishable also by the large regularly obovoid fruit, narrowed to the base and minutely apiculate, and by the fruiting perianth depressedly pedicelliform, and having the remains of the corolla and staminal tube scarcely visible, not large and split into several spreading pieces as in *Pr. Martii*.

11. **PRITCHARDIA KAALAE** Rock, sp. n.

(Plates VI, *A, B*; XXI, *H*)

Description.—A palm about 10 metres high, the trunk gray with longitudinal furrows and pronounced rings. *Leaves* very large, dark green on both sides; blade 115 cm. from ligule to apex along the central line, cut into more than 60 segments which are nearly flat, parted for only about 15 to 20 cm. into acuminate drooping points, green on both surfaces, but rather closely dotted beneath with elliptical, slightly-fringed, light-colored lepidia; transverse veinlets very distinct beneath, the lower costae with fawn-colored woolliness towards the base of the blade; petiole in young leaves nearly 175 cm. long, little shorter in mature leaves, 3.5 to 4 cm. wide at the ligule, 14 cm. wide at the base, covered beneath with a rufous-brown detachable wool, the lower margins fringed with fibers, ligule somewhat triangular, apiculate. *Spadix* branching into two distinct panicles, 2.50 m. long including the panicle, long drooping; the spathes green, sparingly furnished with silvery paleae; panicles many branched, the upper branchlets simple, the four lower lateral branchlets again branching; floriferous branchlets glabrous, 9 to 12 cm. long, somewhat angular, not distinctly sinuous; bractlets 5 to 6 mm. long, thin, filiform. *Flowers* small, 8 to 9 mm. long; calyx campanulate, widest at the apex, narrowed at the base, strongly striate, the teeth short and acute; staminal ring protruding, the filaments subulate from a broader base; anthers linear; corolla segments oblong, margins not parallel, strongly ribbed outside, bluntly acute; ovary very small, sub-turbinate, glabrous, style short sulcate; stigmas punctiform. *Fruit* (not perfectly mature) ellipsoidal-ovoid, somewhat asymmetrical at the base, rounded at both ends but narrower at the base, black when ripe, with one or two lateral ridges when dry, 3 cm. long, 2 cm. wide; whole dry pericarp 2 mm. thick; endocarp brittle, less than one-half mm. thick, seed ovoid to subglobose; the hilum large, ovate, 12 mm. long, 8 mm. wide. Embryo a little above the base. *Fruiting perianth* small, only 2 mm. high and 2.5 mm. broad, remains of staminal ring spreading.

Habitat.—*Oahu*, Waianae range, eastern side of the island in the left fork of Makaleha Valley above a waterfall on the steep ridge, elevation about 1200 feet or more, at the foot of Mt. Kaala. A grove of this species was found first by me when in company with Dr. and Mrs. H. L. Lyon in the spring of 1918. Specimens were collected by Messrs. A. Holm and O. H. Swezey when I accompanied the party on a collecting trip to that locality.

(Rock) no. 17250 in the College of Hawaii Herbarium.

Observations.—This is a remarkable species and somewhat allied to the Kauai species, especially perhaps to *Pr. Hardyi*. It is remarkable for the long inflorescence which measures over seven feet in length, the small flowers, glabrous panicles, and large leaves, which are not densely tomentose beneath as in the Kauai species and *Pr. Martii* from Oahu, but covered with small, scattered, elliptical, slightly fringed lepidia; the leaf blade is dark green on both sides.

12. **PRITCHARDIA MARTII** H. Wendl. in Bonpl. X. (1862) 199; Seem Fl. Vit. 274; H. Mann in Journ. of Bot. VII. (1869) 177 Hillebr. Fl. Haw. Isls. (1888) 451; (in part); Becc. Malesia, III. 296, t. XXVIII. f. 14, 15 and in Webbia, II (1907) 203 (not in Webbia, IV (1913) 223, where the fruit described and figured (f. 14) as that of *Pr. Martii* is of *Pr. macrocarpa*; Drake del Cast. Ill. Fl. Ins. Pac. VII. 323; Rock, Indig. Trees Haw. Isls. (1913) 101.

Livistona? Martii Gaud. Voy. de la Bonite, t. 58, 59 Mart. Hist. Nat. Palm III. 242, 319 (Martiana). ;

Eupritchardia Martii O. Kuntze, Rev. Gen. Pl. III. 2 (1898) 323.

Washingtonia Martii O. Kuntze, Rev. Gen. Pl. II. (1891) 737.

Chamaerops Martii Rev. Hort. 1875, 32.

(Plates VII, A; XXI, E)

Description.—A rather short stemmed palm, 3-5 m. high with a head of robust, rigid leaves. The leaf blade measures about 80 cm. in length from the ligula to apex, is of a thickish coriaceous structure, and deeply cut into numerous segments; has the lower surface of a yellowish or slightly tawny color (when dry), and is very densely clothed with an appressed felt or tomentum, composed of conspicuous, nearly confluent lepidia, leaving very small patches of epidermis uncovered; the lepidia are about as long as broad, very irregularly fringed with relatively large hair-like curved and falcate hyaline cells; the segments are rather deeply parted into two very finely acuminate non-drooping points; central segments 4.5 cm. broad at their disjunction places. Petiole robust, about as long as, or shorter than, the blade, covered in newly expanded leaves with (apparently fugaceous) silvery scales on the upper surface and with a thin appressed tawny tomentum underneath, the latter extending (but apparently also not permanently) to the main costae. *Spadices* elongate, composed of 3 or 4 partial inflorescences or panicles, each of which is sustained by a distinct peduncular part; the general peduncular part is 85 cm. long in one specimen. Spathes rigid, chartaceous, nearly glabrous, being sprinkled only here and there with silvery fugaceous paleae; the panicles are about 20 cm. long, rather loosely branched, twice in their lower

part, simply above; floriferous branchlets glabrous, angular (when dry) and strongly sinuous between the spirally alternate flowers; every flower is furnished with a very long deciduous, setaceous bracteole; fructiferous branchlets subteretorulose, 8-10 cm. long, 2 mm. through at the base. *Flowers* (unopened) 9-10 mm. long, 4 mm. through, somewhat acuminate, and subtrigonus; calyx campanulate, distinctly narrowed to the base, with 3 rather acute teeth, conspicuously (dry) veined; corolla about twice as long as the calyx; the segments lanceolate, more or less acuminate, strongly striately-veined; staminal ring considerably protruding above the calyx; filaments spreading, subulate from a broad base; anthers linear sagittate, blunt; ovary oblong turbinate, sculptured above and narrowed, rather suddenly, into a trigonus, sulcate thickish style; stigmas punctiform. Fruit (immature?) ellipsoidal, narrowed towards both ends, but especially above, and pointed, about 4 cm. long and 28 cm. through (in Gaudichaud's figure). The *fruiting perianth* has the calyx depressedly pedicelliform, callous; but the corolla tube, and the staminal ring protrude considerably beyond the calyx and split into few parts, which are conspicuous objects spreading at the base of the fruit.

Habitat.—The Hawaiian Islands. It was first discovered by Gaudichaud most certainly in the eastern part of Oahu, where it has been collected by Professor Rock in Oct. 1912 (no number) on the edge of precipices at the head of Palolo Valley at over 600 m. elevation, and in Wailupe Valley (nº. 10361) in January 1915, also at about the same elevation. In the Berlin Herbarium are preserved portions of spadices with flowers, apparently belonging to *Pr. Martii*, collected by Lydgate at Cape Niu, also in Eastern Oahu. *Pritchardia Martii* has recently been collected west of Nuuanu Pali, at the head of Moanalua Valley by O. H. Swezey and E. Bryan, also on the windward side on steep cliffs of Waiahole Valley, by O. H. Swezey while on a collecting trip in company with H. P. Agee. The Waiahole and Moanalua specimens are said to have a simple, unbranched spadix, while those occurring in the eastern range have the spadix branched into three or four distinct panicles. The fruits of the Waiahole specimens were immature, while those of the Moanalua specimens were nearly mature and of a subspherical shape, agreeing well in size and form with a mature fruit collected in Palolo Valley.

Observations.—I think that now this old and up to the present imperfectly known species has been exactly identified by means of the specimens collected lately by Professor Rock. Unhappily these specimens carry immature fruits only, which, therefore, look smaller than those represented in Gaudichaud's work, to which otherwise they agree exactly in their regular ellipsoidal shape, and to which it is believed that later they would agree also in size. Prof. Rock wrote me (June 2, 1918) that he went to Palolo Valley and Wailupe Valley into the mountains of Oahu, but that he was not so far able to secure ripe fruits of the typical *Pr. Martii*. He says that in those mountains there are many rats and mongooses which eat the young fruits and that he has actually found rat's nests on the palm of Palolo. More recently, however, Professor Rock has succeeded

in obtaining some thoroughly mature fruits of the Palolo palm, growing at Konahuanui (the highest peak on the Koolau range) which proved to have an entirely different shape from those described above, not being elliptical, but globose and semi-spherical. It is therefore not at all impossible that the fruit figured by Gaudichaud was also an immature one, as it seems a rather common occurrence in *Pritchardias* for the fruit to change in shape until it has reached maturity.

In the picture of the fruit of *Pr. Martii*, in Gaudichaud's work are particularly visible the remains of the corolla tube and staminal ring spreading under the fruit, a peculiarity which I have not observed so marked in any other *Pritchardia*, but which is very plain in Rock's mentioned specimens. Furthermore, the correspondence of the nature of the hairy indument of the lower surface in the leaf blade of Rock's specimens, with that of the actual typical Gaudichaud's specimens is perfect.

Rock's specimen collected in Palolo Valley is accompanied by a small photograph taken (in situ) on the very edge of a precipice. It shows a rather low palm with a short and relatively stout stem and rigid leaves with robust petioles. The specimens from Wailupe Valley (the valley between Palolo and Niu Valley) are accompanied by the following field note: "The palm is short, only 10-15 feet (3-5 m.) tall. The inflorescence branches 3 times (in another note it is 4 times), the fertile flowers are borne on the last branch and densely clustered, while the two lower branches are sterile." Apparently the three inflorescences or panicles, into which the spadix divides, do not expand the flowers at the same time, and probably only a single panicle, the terminal one, produces fruits; but I have not been able to discover any organic difference in the flowers of the various inflorescences; probably there is only a kind of dichogamy between the flowers on the inflorescences of the same spadix.

Pr. Martii is well characterized by its relatively small stature and rather thick short stem; by the peculiar tomentum clothing the lower surface of the leaf blade; by the long spadices composed of 3-4 distinct panicles; and especially by the large, ellipsoidal (or at complete maturity subglobose?) pointed fruit, borne by a perianth having the calyx callous and pedicelliform and the remains of the corolla tube and staminal ring split into a few conspicuous spreading parts. It differs from *Pr. macrocarpa*, to which otherwise *Pr. Martii* is related, in the tomentose undersurface of the leaves, and in the conspicuous pieces of the fruiting perianth. The flowers of *Pr. Martii*, however, are barely distinguishable from those of *Pr. macrocarpa*.

13. **PRITCHARDIA GAUDICHAUDII** H. Wendl. in Bonpl. X. (1862) 199; Seeml Fl. Vit. 274; H. Mann in Journ. of Bot. VII. (1869) 177; Becc. Malesia III, 295 (excl. descript. of spadix and flowers) pl. XXXVIII. f. 11-12; in Webbia, II. 203 et IV. 208, 223; Hillebr. Fl. Haw. Isls. 450 (as to the plant from Molokai only); Rock, Indig. Trees Haw. Isls. (1913) 100.

Livistona ? *Gaudichaudii* Mart. Hist. Nat. Palm. III, 242, 319.

Eupritchardia Gaudichaudii O. Kuntze, Rev. Gen. Pl. III. 2 (1898) 323

Washingtonia Gaudichaudii O. Kuntze, Rev. Gen. Pl. II. (1891) 737.

(Plates VIII, A, B; XX, B)

Description.—Somewhat different in general habit from the other *Pritchardias*. The trunk is rough and from 0.60 to 1.50 m. in height, broad at the base, and attenuate towards the apex. *Leaves* relatively small and very robust, the blade is of a relatively thick structure, nearly leathery, and measures 65-70 cm. from the ligula to the apex, is entire to about the middle in its central part, and cut into relatively not very numerous, broad and rather short segments which divide into two long-acuminate stiff (not drooping) but at times slightly falcate laciniae; the entire blade acquires, in the herbarium specimens, more than any other species, a brown tawny color, deeper below than above; moreover the lower surface is furnished with numerous, yet non-confluent, lepidia which leave good portions of epidermis uncovered, and are scale-like, hyaline, unequal, at times relatively large, lanceolate or elliptical and slightly fringed, especially at their extremities; the central, largest, segments are 5.5-6 cm. broad, apiculate in the centre. Petiole robust, shorter than the blade (55 cm. long and 4 cm. broad at apex in one specimen). In young leaves, the petiole and the base of the blade, on both surfaces, is very densely clothed, more or less permanently, with a silvery or amianth-like woolliness, which is persistent underneath on the mid-costae. *Spadix* about 1 m. long, usually composed of a single panicle carried on a long peduncular part; yet occasionally a second panicle is developed; spathes rigid, chartaceous, at first-scaly paleaceous, later glabrous. The panicle is about 25 cm. long, loosely twice branched in its lower part, and simply branched above, very fugaceously and slightly covered, in youth, with a fulvous soft wool, otherwise glabrous; floriferous branchlets 8-10 cm. long, somewhat angular, when dry, and strongly sinuous between the spirally alternate flowers, 2-3 mm. thick and subterete at the fruiting stage; every flower is furnished with a capillary, deciduous, bracteole. *Flowers* (unopened) 8-9 mm. long, 3 mm. through, narrowed a little above, shortly apiculate, and often slightly asymmetrical; calyx urceolate-campanulate, somewhat narrowed to the base, marked by conspicuous veins convergent to the short, sharp pointed teeth; corolla somewhat more than twice as long as the calyx, its segments broadly, irregularly linear, subhastate, or little narrowed above, obtusely apiculate, strongly striately-veined; staminal ring about level with the mouth of the calyx; filaments very slender, subulate; anthers linear-sagittate, blunt; ovary turbinate, sculptured above, and narrowed into a thickish trigonous, sulcate style; stigmas punctiform. *Fruit* quite symmetrical, spherical, 38-43 mm. in diam., centrically terminated by the very minute remains of the style and abortive carpels; the surface smooth and nearly shiny, not or very faintly marked by longitudinal ridges; of a hazelnut brown color in herbarium

specimens; whole pericarp 4-5 mm. thick; mesocarp grumous and permeated by rather numerous, sinuous, branched fibers; endocarp about 1 mm. thick all around, but thicker at the base, the endocarpal cavity nearly polished white. *Seeds* spherical about 3 mm. through; hilum orbicular, 12-14 mm. in diameter; embryo placed a little above the base. The immature fruit is oblong. *Fruiting perianth* callous, depressed, 5 mm. broad, 2 mm. high.

Habitat.—I hope to have correctedly identified this old species first discovered by Gaudichaud in the Hawaiian Islands, with the specimens of a palm collected by Professor Rock, in May, 1918, on the north coast of Molokai and growing on the cliffs of the Waialeia gorge, immediately above the leper colony of Kalaupapa, at an elevation of about 750 m. (Rock No. 14074). Professor Rock writes to me that he observed the same palm also on the rock islets off the precipitous cliffs whence he obtained his specimens, but he was unable to land on the islet owing to the rough sea. There is not the shadow of a doubt, however, that such islets must once have been part of the overhanging cliffs and that the palms growing thereon were derived from the heights above. It was on these islets that Lydgate collected the fruit, of which I have given a figure in "Malesia" III. b. XXXVIII. f. 11-13, and which corresponds exactly to those of Rock's specimens. That this Molokai palm is really one of the two collected by Gaudichaud in the Hawaiian Islands is extremely probable, in consideration of the fact that clumps of it are plainly visible from the sea, and very likely had been noticed by the naturalists of the "Bonite."

Observations.—Professor Rock, in a letter regarding the palm in question, says that the fruits of *P. Gaudichaudii* "germinate readily, as the ground below the old palms is a mass of young ones." And it is not perhaps too rash to fancy that the palm of which Gaudichaud took living specimens and, in his herbarium, recorded, was smaller than *Pr. Martii*, was growing in the places and under the conditions mentioned by Rock. But the best argument for the identification of *Pr. Gaudichaudii* with the palm of the cliff of Molokai, rests on the perfect correspondence of the nature of the indument that covers the lower surface of the leaves of the type specimens with that covering those collected by Rock. Gaudichaud's type specimens of *Pr. Gaudichaudii* consist only of leaves of very young plants, and have the peculiar tawny color shown also by those recently gathered. Professor Rock remarks also that this species has a different aspect from the other *Pritchardias* by reason of its small stature and rigidity, probably a consequence of the exposed location in which it grows. *Pr. Gaudichaudii* is especially characterized by its large spherical fruit, and by the leaves, which have the lower surface not completely covered with relatively large, scale-like hyaline narrow and long lepidia. As a subsidiary character may also be mentioned the brown color acquired in the herbarium specimens by the lower surface of the leaves, and also by the flowers.

NOTE BY JOSEPH F. ROCK.

Pritchardia Gaudichaudii evidently occurs in all the gulches and valleys, or rather on the ridges between them, from Waialeia to Pelekunu. In Pelekunu proper many palms were observed growing on the steep cliffs of that valley, but no specimens could be collected. Waikolu Valley has also numerous palms growing on the steep walls along waterfalls, whether they all belong to *Pritchardia Gaudichaudii* or represent new species must be left for future explorers. In Waiakapuu Valley the typical *Pritchardia Gaudichaudii* was collected with perfectly spherical fruits; the panicles, however, retained their tomentum more or less. Rock No. 17346 in the College of Hawaii Herbarium.

In O. Meyer's place at Kalae, Molokai, there is a palm in cultivation which must be referred to this species, although no mature fruits could be collected. Rock No. 17340 in the College of Hawaii Herbarium.

14. PRITCHARDIA FORBESIANA Rock sp. n.

(Plate IX, A, B)

Subhumilis. Foliorum lamina firme tenuiter coriacea, utrinque virentia subtus lepidiis minutissimis, linearibus, ferrugineis, crebriusculis conspersa, in parte centrali circiter 90 cm. longa, usque ultra medium integra; segmentis ad 57, majoribus 35-38 cm. longis et ad basin 6 cm. latis profunde bifidis, laciniis acuminatis, rigidis. Spadix brevis et indivisus, paniculam simpliciter ramosam et breviuscule stipitatum ferens; spathis dense appresseque tomentosis; ramulis floriferis fugaciter piloso-floccosis. Flores spiraliter alterni, dum clausi oblongi, obtusiusculi, 8 mm. longi, 4 mm. crassi; calyce cyathiformi-campanulato, basi paullo attenuato, obsolete 3-dentato, glabro, obscure venoso; corolla quam calyx duplo et paullo ultra longiori; urceolo staminali non, vel vix, ex ore calycis exerto, petalis obtuse pluricostulatis. Fructus maturus globosus, 3-3.5 cm. diam. symmetricus; immaturus ellipsoideus, acutis. Perianthium fructiferum depresso pedicelliforme, urceoli staminalis e calyce calloso paullo exsertis.

Description.—A short stemmed palm, trunk 3-4 m. (5 m. C. N. F.) high with a small rigid crown. Leaf blade 72 cm. long from ligule to apex; number of segments about 60; width of median segments 4.5 cm. at their disjunction, divided for about 26 cm. into long acuminate non-drooping points, dotted beneath with elliptical scale-like, slightly fringed to subentire, yellowish lepidia; transverse veinlets very prominently protruding; the lower costae on the under surface of the leaves covered with reddish brown wool, glabrous above. Ligule triangular in young leaves, crescent shaped in old leaves; petioles about as long as the blade or shorter, width at ligule 4 cm. Spadix evidently simple, the spathes ovoid oblong, acute or bluntly acuminate, densely covered outside with a detachable rufous brown wool; panicle short, about 12 cm. long, with many simple branchlets in the upper and middle part, the few lower branchlets dividing once or twice; branches 8 to 10 cm. long, apparently less than 2 mm. through, terete, but somewhat angular when dry, sinuously twisted, with large orbicular projecting pulvini on which the flowers are borne; whole panicle with grayish to yellowish hair or

palea, scattered over its surface; bracts at the base of the pulvini filiform, about 6 mm. long. *Flowers* (unopened) 8 mm. long; calyx short cup-shaped, subtruncate at the apex, the minute teeth bluntly acute, 4 mm. high, 3 mm. through at the base, slightly wider at the mouth, dull and inconspicuously striate; petals linear-oblong acute, 6 to 7 mm. long, of even width throughout, 1.5 mm., apex acute, somewhat striate, especially near the base; staminal ring not or only slightly protruding; filaments short and broad; anthers linear-oblong. Ovary turbinate, sculptured above and terminating more or less abruptly into a slender trigonal style 2.5 mm. long; stigmas minute, punctiform. Fruit ovoid to subglobose when mature and rounded at both ends, 4 to 4.5 cm. long, 3.2 to 3.5 cm. in diameter, slightly asymmetrical at the base; whole pericarp 5 to 6 mm. in diameter; mesocarp grumose and transversed by branching coarse fibres; endocarp hard, woody, light-colored; diameter of seed cavity 22 mm. *Seed* ovoid acute at the apex, rounded at the base; hilum trigonal in outline; embryo situated immediately above the margin of the raphe.

Habitat.—Maui, western portion in the Honokohau Drainage Basin at the foot of Mauna Eke, elevation over 3000 feet, on a small plateau immediately under Mauna Eke, which is only a few hundred or one thousand feet higher. The palm was observed and photographed by the writer, August, 1918, when in company with Mrs. H. P. Penhallow, and T. Hashimoto. No specimens were collected owing to the fact that the palm was without flowers and fruits. The type No. 472 M. is in the B. P. Bishop Museum and was collected by C. N. Forbes, to whom the writer is indebted for the loan of material, and for duplicate specimens which have been deposited in the College of Hawaii Herbarium.

Observations.—A palm of the stature of *Pritchardii Gaudichaudii* and evidently related to that species; the fruits are not exactly spherical, and smaller; the flowering panicle is also much smaller, the branchlets shorter, with large, conspicuous, orbicular pulvini with long bracts at their bases; the flowers are closer set, especially near the apex. The calyx is faintly striate, of nearly equal width and subtruncate. A distinguishing feature is found in the spathes which are densely covered throughout the outer surface with a reddish brown, persistent but detachable wool. The lepidia on the undersurface of the leaves are apparently identical with those found on *Pritchardia Gaudichaudii*.

15. *PRITCHARDIA LOWREYANA* Rock in lit.

(Plates X, *A*; XX, *A*)

Mediocris, caudice 2 et ultra m. longo. Folia utrinque virentia, subtus crebre microlepidiis minutis pallidis punctiformibus vel breviter linearibus non fimbriatis praestita, segmentis rigidis. Spadix ultrametralis, bipartitus. paniculis duplicato ramosis, ramulis glabris. Flores 8-9 mm. longi, calyce campanulato basi attenuato acute venoso. Fructus in genere maximus, ovatus, conice terminatus acutus 6 cm. longus 4 cm. in medio crassus, basi paullo attenuatus, ibique rotundatus semine ovato, superne conico. Perianthium fructi ferum depressum.

Description.—A somewhat larger plant than *Pr. Gaudichaudii*, and equally endowed with robust rigid leaves; the trunk 2 m. long or more. *Leaf blade* of a

thick almost leathery structure; it measures about 1 m. from the ligula to the apex, is entire to above the middle in its central part, otherwise cut into rather numerous large segments, which soon subdivide into two long, acuminate, stiff (non-drooping) usually slightly falcate laciniae; it is apparently equally green and glabrous on both surfaces, but is closely dotted underneath with minute, light colored, orbicular, elliptical, or shortly linear not fringed lepidia; the central, largest, segments are up to 6 cm. broad at their disjunction places; ligula large, rounded-oblong. Petiole robust, a little shorter than the blade (90 cm. long, and 4 cm. broad at apex in one specimen). In the adult leaves, the petiole and the base of the blade are almost glabrous on both surfaces, except on the lower costae, which are more or less permanently cottony. *Spadix* (whole) 1-1.20 m. long, and drooping; it divides into two partial inflorescences, but of these only the upper one bears an enormous cluster of fruits (Rock). The spathes sheathing the long peduncular part, are, at the fruiting stage, glabrous, much slashed and marcescent. The fruiting panicle is dense, has the lower branches divided into 2-3 branchlets, and is simply branched above; floriferous branchlets glabrous, 10-12 cm. long, slender and somewhat angular (when dry) and strongly sinuous between the spirally alternate flowers; at the fruiting stage are subterete and 2-3 mm. thick. Every flower is furnished with a capillary deciduous bracteole. *Flowers* (unopened) 8-9 mm. long, 3 mm. through, very similar to those of *Pr. Gaudichaudii*, narrowed a little above acute and often slightly asymmetrical; calyx campanulate, narrowed to the base, distinctly veined, the veins converging to the short sharp pointed teeth; corolla somewhat more than twice as long as the calyx; its segments broadly irregularly linear subhastate, acute, strongly striately veined; staminal ring about level with the mouth of the calyx; filaments subulate; anthers linear, sagittate, blunt. *Ovary* turbinate, sculptured above, and narrowed into a thickish, trigonous, sulcate style; stigmas punctiform. *Fruit* very large, quite symmetrical, ovoid, broadly conical in its upper part, acute, 6 cm. long, 4 cm. through at its middle, slightly narrowed to the base, which, however, is rounded; the surface is smooth and rather shiny, not, or only very faintly, marked by longitudinal ridges; it is of a deep brown color in the herbarium specimens, but the mature fruit is black (Rock); whole pericarp 5-6 mm. thick, mesocarp grumous and permeated by rather numerous sinuous branched fibers; endocarp woody, about 1 mm. thick on the sides, pointed and considerably thickened at the base; the endocarpal cavity is nearly polished white. *Seed* ovate, conical in its upper part; hilum orbicular, 12-14 mm. in diameter. *Fruiting perianth* callous, depressed, very shortly pedicelliform.

Habitat.—*Pr. Lowreyana* was discovered in June, 1918, by Professor Rock at Waialeia on Molokai, immediately above the leper colony, at an elevation of about 650 m. It was found at the same time with *Pr. Gaudichaudii*, not, however, on the cliffs overhanging the sea (the station of the latter) but inland on the flats, and was growing among masses of *Freycinetia arborea* Gaud. Professor Rock distinguishes this fine palm with the specific name of *Lowreyana* in "honor of the late Mrs. F. J. Lowrey of Honolulu, an ardent admirer of palms, who was in a measure responsible for the embellishment of this city."

Observations.—It is related to *Pr. Gaudichaudii* and must have had a common derivation with it. The flowers of the two plants are almost indistinguishable

the one from the other, but *Pr. Lowreyana* is the larger plant of the two, and is quite distinct from *Pr. Gaudichaudii* in its larger, ovate, conically pointed fruit, and in the different aspect of the lower surface of the leaf-blade, which is dotted with a quite different form of lepidia.

***Pritchardia* var. *turbinata* Rock v. n.**

(Plates X, B; XXII, J) v. n.

Description.—A palm of the habit of *Pritchardia Gaudichaudii* but somewhat larger and thus intermediate between the former and *Pritchardia Lowreyana* Rock. Trunk 1.5 m. or slightly more. *Leaf blade* thick coriaceous, 88 cm. long from ligule to apex, the segments divided about 30 cm. into stiff non-drooping acuminate points, which are slightly falcate as in the species; dark green above and paler beneath and dotted with oblong-elliptical yellow non-fringed lepidia; petiole about 80 cm. long. *Spadix* branching into two separate panicles, long drooping but shorter than in *Pr. Lowreyana* Rock. *Flowers* as in the species, the calyx less conspicuously striate. *Fruit* ovoid, acute at both ends, black when mature, 4.5-5 cm. long including the fruiting perianth, nearly 3 cm. in diameter; exocarp very thin; mesocarp slightly grumous and permeated by less numerous branched fibers; endocarp pale yellow, silky glossy, with numerous impressed branching veins and reticulation; whole pericarp 2.5 mm. thick. *Seed* subglobose, but pointed at the apex, broader than high, 22 mm. in diameter; embryo situated immediately above or at the upper margin of the hilum.

Habitat.—Molokai on the Waialeia ridge in company with *Pritchardia Gaudichaudii*, *Freycinetia arborea* Gaud., *Sadleria*, etc.

Observations.—This variety differs from the species in its smaller stature, which approaches that of *Pr. Gaudichaudii*, but mainly in the fruits which are smaller and evenly pointed at both ends, being thickest at the middle; the panicles are shorter than in the species and also smaller. The whole pericarp is very thin, only about 2 mm. instead of 4-6 mm. as is the case in *Pr. Lowreyana*. It might be regarded as a distinct species, but fruits of *Pritchardia* vary considerably; possibly intermediate between *Pritchardia Gaudichaudii* and *Pritchardia Lowreyana*. Hybridisation very likely occurs in *Pritchardia* through anemophily. The locality in which the two mentioned species and variety grow is exposed to the trade winds which sometimes assume the velocity of a gale. The variety in question, of which there were two or three plants, grew in a clump of *Pritchardia Gaudichaudii*. *Pritchardia Lowreyana* grew several hundred yards inland on the flats, but in line with the prevailing wind. Entomophily must, however, also be considered, since the flowers are usually visited on sunny days by native wasps and bees. The type is No. 17344 in the College of Hawaii Herbarium.

16. **PRITCHARDIA BREVICALYX** Becc. et Rock, sp. n

(Plate XXIII, P)

Foliorum lamina ampla haud spisse subcoriacea, utrinque virentia, subtus lepidiis minutissimis crebriusculis conspersa, in parte centrali circiter 1.50 m. longa, profunde multisecta; segmentis numerosissimis, elongatis, flaccidis; majoribus 3.5 cm. basi latis; omnibus profunde bifidis, laciniis pendulis, longissime acuminatis et in apicem filamentosum extenuatis. Spadix amplius, elongatus, fere a basi in 3 inflorescentias partiales divisus; spathis chartaceis, cito glabris; paniculis 25-30 cm. longis, laxe ramosis; ramulis floriferis tenuibus, glabris. Flores laxè spiraliter alterni, 12 mm. longi, calyce campanulato, basi valde angustato, 4 mm. in ore lato et minus alto, acute 3-dentato et venoso; corollae et staminum tubo calycem duplo et ultra superanti; petalis asymmetricè lanceolatis et plus minusve flexuose acuminatis. Fructus globoso-subobovatus, basi symmetricus, apiculatus, 30-33 mm. crassus et paullo ultra longus; mesocarpis grumoso. Perianthium fructiferum depresso pedicelliformi, urceoli staminalis exsertis e calyce calloso paullo exsertis.

Description.—A rather large palm of the size and habit of *Pr. Hillebrandi*. *Leaf blade* of a not very thick structure, measuring about 1.50 m. from the ligule to the end of the central segments, equally green on both surfaces, sprinkled underneath with minute lepidia, otherwise glabrous; the segments are very numerous, relatively narrow, flaccid and long, deeply divided into two very long acuminate hanging laciniae which taper very gradually to an extremely fine, very long, filamentose apex; the largest intermediate segments are 3.5 cm. broad at their disjunction, and 60-70 cm. long if the capillary end is taken into account; the outer segments are narrower and shorter, but equally bifid, and have also filamentose apices. *Petiole* quite glabrous; *ligula* asymmetrically crescent-like, apiculate in the middle; the young leaves are covered at the base, especially on the dorsum, with a soft light-colored, detachable fluff. *Spadix* elongate (1.40 m. long in one specimen) composed of 3, almost equal, partial inflorescences, which arise separately from within the mouths of the lower spathes, near the base of the main rachis, the one a little above the other; the general sheathed peduncular part is 3.5 cm. thick. The partial inflorescences are composed of a loose panicle, borne by a long rachis, which is as thick as a finger, and is sheathed by 4-5 rather spaced spathes; the latter are tubular in their lower part, and expand above into a rather broadly lanceolate, rigid-chartaceous, concave, ass's earlike, pointed blade; in youth, the spathes are more or less furnished with a silvery or amianth-like fluff, which very soon disappears, leaving their surface quite glabrous. The panicle has the lower branches 2-3-partite, and simple floriferous branchlets in its upper part; the fructiferous branchlets are quite glabrous, terete 10-12 mm. long, 2 mm. thick at the base, and have tubulate apices. *Flowers* rather loosely spirally alternate, rather large, the unexpanded ones are 12 mm. long and somewhat asymmetrically acuminate; calyx glabrous, shortly campanulate, not quite 3 mm. high and 4 mm. wide at the mouth, contracted to a narrow base, and marked by sharp veins converging to 3 triangular very acute teeth; the staminal and corolla tube protrudes considerably beyond the calyx, being twice and more as long as the latter; the stamens have rigid radiately

spreading filaments; ovary turbinate; petals irregularly lanceolate, having more or less wavy acute or acuminate apices. The *fruit*, when thoroughly mature, is globose-ovoid, or subobovoid, acutely mucronate by the remains of the sterile carpels, symmetrical at the base, 35-37 mm. long; 30-33 mm. through; of a hazel nut brown color, and with a nearly polished, slightly uneven surface; the young fruit is elliptical or subobovate-elliptical, and tapering towards the base; mesocarp grumose, not fibrous; endocarp thin but very hard. *Seed* spherical. *Fruiting perianth* depressedly pedicelliform; the calyx callose; the staminal and corolla tube form a narrow toothed ring.

Habitat.—The Island of Molokai. It was collected by Professor Rock in May, 1919, in Wailau Valley, where presumably it was a cultivated plant. No. 16000 of the College of Hawaii Herbarium.

It differs from all the Pritchardias known to me in its very short, sharply 3-toothed, campanulate calyx, and in the very elongate corolla and staminal tube, which protrudes considerably outside the mouth of the calyx. It is also characterized by its glabrous floriferous branchlets, by the large leaf blade, green on both surfaces, and sprinkled underneath with minute lepidia, but otherwise glabrous, and cleft into relatively long segments, which have extraordinarily long, hanging, filamentose apices; and finally by its rather large globose-subobovoid, symmetrical fruit. It does not seem to me closely related to any other species, but it may be, however, located in the conspectus with the species having glabrous floriferous branchlets, and fruits over 3 cm. in diameter.

17. **PRITCHARDIA BECCARIANA** Rock. Torrey Bot. Club Bull., 1916, 43:386, Pl. 21.

(Plates XI, *A, B*; XXIII, *M*; fig. I, II a and b.)

Elata, caudice gracili leviter flexuoso, foliis amplis suborbicularibus, petiolo elongato, lamina tenuiter coriacea, subtus lepidis numerosis, parvis, ellipticis, hyalinis, fimbriatis conspersa. Spadix 3-5 partitus, paniculae ramis glabris et inter flores sinuosis. Flores remotiuscule spiraliter alterni, pro rata majusculi et angusti (12-13 mm. longi, 3.5 mm. crassi); calyce cyathiformi-cylindraneo, sublignoso, laevi vel ad denticulos obsolete nervoso; corolla calyce duplo et ultra longiore, segmentis sublinearibus; annulo staminali conspicue ultra calycis faucem producto; ovario apice non sculpto, in stylum sensim attenuato. Fructus majusculus (2.5-3 cm diam.) globosus, vel globoso-oblongus, utrinque rotundatus, basi saepe paullo asymmetricus. Perianthium fructiferum depressum, brevissime pedicelliforme.

Description.—A beautiful palm having a slender, slightly sinuous and closely ringed stem 15-18 m. high, 20 to 30 cm. in diameter, with a large globular crown of leaves (Rock). The *leaves* of young plants have petioles up to 3 m. long reduced, however, to 1.20 m. in the adult plant. Leaf blade nearly explanate, very large, nearly orbicular, of a thinly coriaceous, tough structure, green, dotted rather densely on the lower surface, with small, hyaline, irregularly elliptical, fringed lepidia; the intermediate segments considerably narrower, more deeply cleft and with slenderer and more acuminate, more or less drooping points. The

whole *spadix* is about 1.50 m. long, composed of several (5) nearly equal partial inflorescences, which are separated from each other near the common base, and carry solitary panicles at the end of long slender peduncular parts. *Spathes* rigid, scantily covered with fugaceous, silvery or brownish paleae, and are finally almost glabrous. The panicles are about 30 cm. long, and twice branched; apparently only the uppermost of the 5 panicles carries fertile flowers; the floriferous branchlets are short and thickish, 5-6 cm. long, glabrous, terete, zigzag sinuous between the alternate rather distant flowers. The unopened *flowers* are narrow and relatively long (12-13 mm. long, 3.5 mm. through) bluntish often asymmetrical, calyx cyathiform-cylindrical, shortly 3-toothed, not or very obsoletely veined on the teeth of a hard texture, shortly solid at the base. Corolla twice or even a little longer than the calyx, the segments broadly sublinear, striate, staminal ring neck-like, protruding considerably beyond the calyx; filaments rigid, radiating, anthers linear-sagittate, bluntish; ovary conical, not sculptured above, gradually narrowed into the thickish, 3-sulcate style. *Fruit* somewhat variable in shape, ranging from oval to spherical, apparently usually not quite symmetrical and with a slightly gibbous base, 3-3.5 cm. long, 2.5-3 cm. in diameter, made distinctly mucronate by the remains of the style; the surface is polished and black; mesocarp strongly fibrous; endocarp polished and cinnamon-brown inside, thinly woody. *Seed* spherical, 18-20 mm. in diam. *Fruiting perianth* depressed, and very shortly pedicelliform, 5 mm. broad, 2 mm. high.

Habitat.—It grows on the island of Hawaii about six miles in the forest, elevation 1100 m., in the forest near Glenwood, which lies 22 miles on the road to Kilauea Volcano. Collected by Rock and Copeland on December 23, 1914. (No. 10356 in the College of Hawaii Herbarium.)

Observations.—About this *Pritchardia* Professor Rock informs me that it is a beautiful palm of fine symmetry. The spadix has five main branches (in No. 10356) the four lower branches seem to be sterile and have spreading floriferous branchlets, while the last one is densely clustered, and the branchlets are very short and bear fertile flowers. It is a very distinct species, and very different from any other *Pritchardia* known to me. There are hundreds of them in the forests near Glenwood. The leaves resemble more those of *Pr. pacifica* than those of any Hawaiian species, and their upper sides are convex with shallow furrows, while the leaves of the other species are unevenly wavy, thus neither convex nor concave. The fruits of *Pr. Beccariana* seem to be extremely variable, and vary in size and shape, even on one and the same inflorescence, from globose to ovoid. Whether this variability has anything to do with certain insects which attack the fruits I am unable to say. *Pr. Beccariana* is especially characterized by: the tall stem and large leaves, the latter having the intermediate segments cleft into non-drooping apices, and sprinkled, but not very closely, on the lower surfaces with small hyaline, elliptical, fringed lepidia; by the spadices composed of 3-5 partial inflorescences, and having glabrous, floriferous branchlets; by the calyx being tubular-cylindraceous and of a hard texture; by the staminal ring protruding considerably above the calyx; by the conical not sculptured ovary, gradually pass-

ing into a thickish sulcate style; by the globose, rather large fruit, slightly asymmetrical at the base, distinctly mucronate, and with the mesocarp thickish, easily dissolving into coarse fibers.

***Pritchardia Beccariana* Rock var. *Giffardiana* Becc.**

(Plate VII, *B*; fig. I, III a, b, c.)

Description.—A smaller plant than the type and with a shorter stem. The flowers also are a little smaller (11-12 mm. long) having the calyx a little shorter, and the nerves, converging to the teeth; rather distinct; the fruit is oblong, 3.5 cm. long, slightly excentrically mucronulate, and somewhat asymmetrical at the base.

Habitat.—This palm, according to the collector, Professor Rock, (No. 12799) comes from the region near the Volcano of Kilauea, Hawaii, and grows in the humid rain-forest at an elevation of 4200 feet (1270 m.) or about 2000 feet (609 m.) higher than *Pr. Beccariana*. It occurs on the land opposite Mr. Giffard's residence, some miles in the forest. At the request of Mr. Rock this variety is named after Mr. Giffard, who was instrumental in securing the specimens.

Observations.—Professor Rock says that this is a tall and stately palm, with large leaves, which do not, however, reach the enormous size of those of *Pr. Beccariana*. The trunk is tall and smooth, of a gray color with longitudinal slits, about 30-35 feet (9-10 m.) tall and about 1 foot (30 cm.) in diameter. The fruits are smaller than those of *P. Beccariana*. The spadix branches 3 times instead of 5 times, as is the case in the latter. Professor Rock supposes his No. 12799 to be a species distinct from *P. Beccariana* (No. 10356), but from the herbarium specimens at my disposal, I have not been able to discover any character by which it could be considered as an autonomous species. The flowers are perhaps a little smaller than in type, the ovary is a little shorter, but on the whole they offer quite the same characteristics. Professor Rock points out the peculiarity of the asymmetrical base of the fruit in his No. 12799, but the same occurs in the fruits of the typical *Pr. Beccariana* (No. 10356). A central portion of a leaf of No. 12799 measures 1.30 m. from the petiole to the end of the central segments; the latter are 5 cm. broad at their disjunction places, and are split at the apex for the extent of 25 cm. into two very acuminate, rigid, non-drooping points. The leaves in the herbarium specimens acquire, especially on the lower surface, a faint tawny color; the same occurs also in the *forma typica*.

18. **PRITCHARDIA ROCKIANA** Becc. in Webbia IV (1913), 228; f. 16; Rock, Indig. Trees Haw. Isls. (1913), 105.

(Plates V, B; XXI, G)

Description.—A small tree, 5 m. high, stem 30 cm. in diam. and of a gray color (Rock). *Leaves* large, the blade measures 1.15 m. from the ligula to the apex, and has the lower surface entirely clothed with a light yellow, nearly golden, very appressed and adherent tomentum composed of hyaline scale-like, much fringed and felled lepidia; the segments are very deeply parted into two very long, gradually tapering, filiform points; the central segments are 4-4.5 cm. broad at their disjunction places. Petiole appressedly (not woolly) tomentose on the lower surface; and with the same kind of tomentum extending to the dorsum of the costae. *Spadix* composed of a rather diffuse thyrsoid panicle, about 20 cm. long, borne on a rather elongate peduncular part (40 cm. long in one specimen). *Spathes* tubular in their lower part and expanded above into a rather large lanceolate, acuminate ass's ear-like, very rigid, thinly coriaceous, scaly-furfuraceous blade; the naked peduncular part or rachis of the spadix is finely rusty tomentose, terete, 1 cm. through towards the base, and slightly flattened above. The panicle consists of a few, 2-3-partite branches in its lower part, and of simple floriferous branchlets elsewhere; the latter are finely rusty-tomentose, zigzag sinuous between the spirally alternate flowers, 8-12 cm. long, 2.5 mm. thick at the flowering time, or about 4 mm. thick when bearing the fruits. Floral bracteoles setaceous, very long. *Flowers* (unopened, and apparently not fully developed), elongate-ovoid, about 1 cm. long, and 4-4.5 mm. through near the base, narrowed above to a conical, obtusely trigonous, acute point; calyx glabrous, tubular and slightly ventricose, being broad and solid at the base, restrained a little at the mouth, and with 3 rather prominent, acute not veined teeth, and with a solid base. Corolla only one-third longer than the calyx (in the flowers at hand); the segments elongate triangular, acute, marked externally by 7 explanate ribs, separated by narrow furrows; staminal ring slightly protruding beyond the calyx; filaments filiform; anthers elongate-sagittate; ovary turbinate, strongly sculptured above, and conically narrowed into a trigonous, sulcate, thickish style; stigmas punctiform. The fructiferous panicle is recurved and has very spreading branches. Fruit large, obpyriform, rounded above and rendered distinctly apiculate by the remains of the abortive carpels, 5 cm. long and 3 cm. through at about its upper third, and from thence gradually narrowed to a thickish base. The whole pericarp (dry) has walls about 4 mm. thick in the central and upper portions, but is entirely solid in its lower third portion; the dry mesocarp is grumous and permeated by many fine longitudinal fibers, and, apparently, is somewhat fleshy when fresh; endocarp woody, about two-thirds of a mm. thick, and prolonged below into a thick, obconical acute, woody tail; the seed cavity is slightly longer than broad (27 mm. long, 23 mm. broad) and occupies only the upper two-thirds of the fruit. *Seed* globose subovoid, with round vertex; hilum orbicular, 7-8 mm. in diam. *Fruiting perianth* shortly pedicelliform, 7-8 mm. broad.

Habitat.—Discovered by Professor Rock in August, 1911, at about 700 m. elevation in the rain forests of the northern slope of the Koolau range, Punaluu on Oahu.

Observations.—Easily distinguishable by the leaf blade being subaureous tomentose underneath; by the minutely rusty-tomentose floriferous branchlets, and especially by the large obpyriform fruit, which has its lower third part solid internally. The fruit represented in *Webbia* 1 c. fig. 16 is about one-tenth smaller than natural size.

19. **PRITCHARDIA HARDYI** Rock sp. n.

(Plates XIII, *A, B*; XXIV, *R*)

Description.—A palm 20 m. or more high, with a slender trunk 20 cm. or more in diameter; leaves larger than in *Pr. minor*, flexuous with drooping segments; leaf blade 100 cm. long from the ligule to the apex, coriaceous; lower surface densely tomentose with appressed light golden yellow, much fringed lepidia in the young and old leaves; segments 60, the central ones nearly 5 cm. wide at their disjunction places, parted about 35 cm. into two acuminate somewhat flexuous points, glabrous above with the exception of the upper costae which are covered with a silvery white coarse woolliness; ligule almost truncate. Petioles about 75 cm. long, about 3.5 cm. broad at the ligule, covered with a deep rufous deciduous tomentum as are the lower costae. *Spadix* long, drooping, branching into three distinct panicles, 2.26 m. long, 6.5 cm. broad at the base. Spathes long tubular in their lower part, expanded above into an elongate acuminate strongly chartaceous to coriaceous blade, which later becomes slashed; spadix and spathes covered with a detachable rufous tomentum; panicles covered with a short, not detachable rufous tomentum; branches simple, straight, erect, only the two lowest branches, branching again once or twice; branchlets zigzag-sinuous, 10 to 12 cm. long, when with fruit. *Flowers* spirally alternate, 11 to 12 cm. long when unopened, 3.5 cm. in diameter, oblong, apiculate; calyx cyathiform, puberulous, three-toothed, very inconspicuously striately veined and only immediately near the teeth; corolla longer than the calyx 6.5 mm. long, the segments oblong, bluntly acute, not prominently striate; staminal ring reddish, protruding 1.5 mm. beyond the calyx; the filaments subulate, 1.5 mm. long; anthers linear, 3 mm. long, broader at the base, slightly emarginate at the apex; ovary smooth, truncate at the apex, with a trigonous, sulcate style; stigmas punctiform. *Fruit* asymmetrical, ellipsoidal to obovoid, rounded at the apex but apiculate by the remains of the abortive carpels and at the ventral side somewhat flattened, black when ripe, striate, thickest in the upper third, 2 cm. long, 16 mm. thick; pericarp very thin, less than 1 mm. thick when dry; mesocarp very scanty; endocarp thin, pale yellowish, brittle. *Seed* ovoid 12 to 13 mm. long, 10 mm. wide, rounded at both ends, flattened on the raphe side; hilum irregularly ovoid; embryo 2 mm. above the hilum. *Fruiting perianth* cylindrical, truncate, with spreading staminal cap.

Habitat.—Kauai, on the Lihue side along the Pole Line Trail near Summit Camp, 1900 feet elevation, first observed by Mr. W. V. Hardy of the U. S. Hydrographic Survey; collected by J. F. Rock, January 30, 1920; flowering and fruiting type No. 17296 in the College of Hawaii Herbarium.

Observations.—A very handsome, and one of the tallest species, allied to *Pritchardia minor*. It is easily distinguished from both *Pr. eriophora* and *Pr. minor*, in the much larger crown, in the long drooping spadix which branches into three distinct panicles, and in the short non-detachable tomentum covering the actual panicles, which are simple branched; the flowers are longer than in either species, and the calyx is very inconspicuously striate and only at the very apex near the teeth, besides being puberulous. The fruit is smaller than in either of the other two described species from Kauai. Named for Mr. W. V. Hardy, who called my attention to this species.

20. **PRITCHARDIA MUNROII** Rock sp. n.

(Plates XIV, *A, B*; XXIV, *U*)

Description.—A palm about 4 to 5 m. tall including the crown, trunk gray, smooth and inconspicuously ringed; about 20 cm. in diameter. *Leaves* small, the blade measuring from ligule to apex 88 cm. in length, segments 70 in number, 4 to 5 cm. wide at their disjunction places, deeply divided (35 to 40 cm.) into long very acuminate drooping points with long filaments between the segments, pale green and glabrous above, the lower surface with scattered small elongate-elliptical, entire, hyaline lepidia; the lower costae on the under surface of the leaves densely covered with broad, long, many-nerved silky, pale fawn-colored translucent paleae; ligule triangular, apiculate; petiole 85 cm. long, 2.5 to 3 cm. wide at the apex, 14 cm. broad at the base, thick coriaceous, with long fibers along the margin densely covered beneath with a detachable, compact brown wool, glabrous above except in the young state when it is sparingly covered with a silvery white woolliness, as are also a few of the lower costae on the upper leaf surface in young leaves. *Spadix* 52 cm. long including the 12-13 cm. long panicle (fruiting stage), branching into two separate panicles, lower portion flat-compressed, about 4 to 4.5 cm. broad at the base, the peduncular part 8 mm. in diameter; flowering panicles 10 to 11 cm. long, enveloped by five ovoid, acute spathes, more than 12 cm. broad, 20 cm. long, the tubular portion twice as long or longer, glabrous when old but with a grayish detachable scattered wool towards the apex; flowering panicle 10 to 11 cm. long with numerous branchlets, simple branched above, the lower ones dividing into six branchlets; branchlets 3 to 4.5 cm. long when with flower, 6 cm. long when with fruit, erect or vermiformly twisted and covered throughout with a dirty grayish brown tomentum, somewhat angular and marked with conspicuously spirally alternate notches for the insertion of the flowers. *Flowers* (unopened) 7 mm. long, 3 mm. in diameter in their median part; calyx glabrous, strongly striate, wider at the apex, narrowing towards the base, the latter oblique; calycine teeth very short, bluntly acute and broadly triangular; corolla segments elongate oblong, striate, nearly 5 mm. long, 1 to nearly 2 mm. broad and narrower at the base; staminal ring not protruding beyond the

calyx; anthers sagittate; ovary turbinate, conically narrowing into a sulcate style. *Fruit* subspherical, glossy, yellowish to grayish brown when mature, 22 mm. long, 20 mm. broad, somewhat truncate at the base, with one or two more or less pronounced ridges; mesocarp deep black, nearly 3 mm. in diameter, grumose and accompanied by several strong stiff fibers; endocarp hard woody 0.5 mm. in diam. *Seed* ovoid, the apex slightly pointed with wart-like protuberance, otherwise rounded, yellowish brown in color and marked with paler streaks, about 13 mm. long, 10 to 11 mm. in diameter. Hilum large, oblong; embryo not far from the upper raphe margin. *Fruiting perianth* missing.

Habitat.—Molokai, leeward side, at an elevation of 2000 ft. above Kamalo and near or at Puakoolau, in a dry gulch, associated with *Xanthoxylum muiense*, *Dodonaea stenoptera*, *D. viscosa*, *Sida*, *Maba sandwicensis*, *Dracaena aurea*, etc.

Observations.—A very remarkable species, easily distinguished by the very small panicles which are densely covered with dirty grayish brown hair and by the small subglobose fruits which resemble those of *Pritchardia remota* Becc. The leaves of *Pritchardia Munroii* Rock are covered in the lower portion, especially on the costae of the under surface, with large and broad translucent paleae which are larger than in any other species known. It is the only species with globose to subglobose fruits and densely woolly panicles; the fruits alone resemble those of the *Pritchardia remota*, or *Pr. affinis*. The species is named for Mr. James Munro, manager of the Molokai Ranch, who is an ardent and keen supporter of the natural sciences, and to whom the writer is indebted for many kindnesses. The species was discovered February 20, 1920, Mr. Munro and Mrs. L. M. Dunbar being present: Rock No. 17342, type in the College of Hawaii Herbarium. The species has also been under cultivation on Molokai at the home of Mr. O. Meyer at Kalae; here a plant from which specimens were collected has been growing for many years, but has a trunk only about 2 feet in height: Rock No. 17341 in the College of Hawaii Herbarium.

21. **PRITCHARDIA ARECINA** Becc. in Webbia, IV (1913) 224 f. 14; Rock, f. 14; Rock, Indig. Trees Haw. Isls. 107.

(Plates XV, A; XX, D)

Description.—One of the largest. Stem 10-12 m. high and 50 cm. (or less ?) in diam. *Leaf blade* 1.30 m. long from the ligula to apex, and parted to above the middle into about 60 segments; the lower surface is entirely clothed with a light yellow, nearly golden adherent tomentum, composed of hyaline, scale-like, much fringed and felted lepidia; the segments are very deeply parted into two very long laciniae which taper very gradually to filiform apices; the central segments are 5-6 cm. broad at their disjunction places. Petioles stout and broad (4.5-5 cm. broad at apex), covered on the lower surface with a fulvous, more or less removable tomentum, which extends to the dorsum of the costae; ligula short, crescent like, distinctly apiculate. *Spadices* elongate, composed of an ovate thyrsoid panicle, about 20 cm. long, borne on a very long terete peduncular part,

which in one specimen is 1.15 m. long, and, when sheathed by its several tubular spathes, is 2.5 cm. through; the spathes are lacerate in their upper part, and more or less clothed with a fuscous woolly tomentum; the rachis or naked peduncular part of the spadix is 15 mm. in diam. and very densely woolly tomentose; the upper spathes embrace nearly completely the panicle, and have a concave ass's ear-like acuminate, thinly coriaceous, more or less permanently tomentose, finally slashed blade. The *flowering panicle* is erect, slightly shorter than the spathes, rather dense, composed of a few 2-4 partite branches in its lower part, and of simple floriferous branchlets elsewhere; the latter are 8-12 cm. long, relatively thick (about 5 mm. through), permanently clothed with a very dense tomentum of short yellowish hairs, are somewhat angular, and marked with rather deep, irregularly spirally alternate notches for the insertion of the flowers; bractioles inconspicuous (deciduous?). *Flowers* relatively large, 12-14 mm. long (when unopened) and 5-6 mm. through in their lower part, slightly narrowed above to a conical, obtusely trigonous, subacute point; calyx hairy-woolly, cyathiform, campanulate with three small acute teeth; corolla more than twice as long as the calyx, the segments elongate-triangular, acute, obsoletely striate; staminal ring very short, not protruding above the calyx; filaments subulate from broad bases; anthers narrow, elongate, distinctly two-auricled, sagittate at the base; ovary turbinate, strongly sculptured above, suddenly narrowed into an elongate, subulate, acutely 3-gonous style; stigmas punctiform. *Fruit* large, not very regularly globose ovoid, 4.5 cm. long, 38-40 mm. through, rounded at both ends, and conspicuously apiculate by the remains of the abortive carpels; the surface (in the dry fruit) is nearly polished, and of a very dark brown color; whole pericarp 6-7 mm. thick; the mesocarp is traversed by numerous, very fine, soft, longitudinal fibers, which at complete maturity separate from each other, especially at the base; endocarp woody, thin and brittle, one-half to two-thirds of a mm. thick, prolonged at the base into a woody obconical, very acute base; endocarpal cavity 22-25 mm. in diameter. *Seed* globose-ovoid, somewhat longer than broad, distinctly conically apiculate; hilum orbicular. *Fruiting perianth* slightly accrescent, thickish, pedicelliform, 8 mm. through.

Habitat.—Discovered by J. F. Rock, May, 1911, on the northern slope of Mt. Haleakala on the island of Maui, in dense swampy forest above Honomanu, at about 1000 m. elevation (Rock No. 8821). Rock writes (l. c.) that "one single tall specimen was also observed above Nahiku, on the same mountain at 4000 ft. (1200 m.) elevation along a stream bed."

Observations.—A very fine, large and distinct species, not likely to be confounded with any other, characterized by the leaf blade which is covered on the lower surface with an adherent light-yellow nearly golden tomentum; by the densely hairy-tomentose floriferous branchlets; by the hairy calyx; and by the large globose-ovoid fruit having the mesocarp dissolved, at perfect maturity, especially at the base, into fine soft fibers exactly as in the fruit of *Areca Catechu*, the fruit of which is very similar in size and shape to that of *Pr. arecina*. It approaches *Pr. lanigera* and *Pr. eriostachya* in its densely hairy floriferous branchlets, but these latter have the calyx glabrous, whereas it is distinctly hairy

woolly in *Pr. arecina*; moreover in this latter the floriferous branchlets are clothed with a short dense tomentum, whereas the tomentum in *Pr. lanigera* as in *Pr. eriostachya* is composed of ruffled hairs.

22. **PRITCHARDIA MONTIS-KEA** Rock sp. n.

(Plates XVI, *A*, *B*; XX, *C*)

Description.—Palm 5 to 8 m. tall; trunk gray, smooth 20 to 25 cm. in diameter. *Leaves* wider than long, consisting of 70 segments; length of blade 93 cm. from ligule to apex, width of frond 150 cm. widest portion; thick, coriaceous, of a rich green color, glabrous, above, and glossy, with small, hyaline, slightly fringed, elongate elliptical lepidia scattered beneath, especially so in the young frond; width of central segments at their disjunction places 5.55 cm., parted about 20 cm. into acuminate non-drooping points; lower costae covered on both sides with a silvery to ash-gray tomentum; ligule crescent-shaped, not apiculate, rounded and irregular; petiole 65 cm. long, 4.5 cm. wide at ligule; 6.25 cm. wide at the base, slightly floccose but later glabrous; filaments present between segments of young leaves, but absent in old leaves. *Spadix* branching into three distinct panicles at equal intervals; whole spadix 105 cm. long, 4 cm. wide at the base; main peduncle 12 mm. wide; spathes 30 cm. long including the 10 cm. long tubular portion, ovate, acuminate, strongly concave, with fawn to pinkish colored tomentum which turns grayish when old; flowering panicle 10 cm. long, the branches thick and short, 5.5 to 6 cm. long, simple in the upper part, the lower branching into three branchlets, covered densely with a reddish brown to fawn-colored silky wool on all its parts; fruiting panicle larger, 20 cm. long, with horizontally spreading branches, the lower twice branching; branchlets nearly 1 cm. in diameter at the base, about 8 cm. long, and covered with the dense silky persistent wool. *Flowers* (unopened) 11 mm. long, arranged spirally and inserted on circular projecting tubercles; calyx urceolate, broader at the base, 6 mm. long, 5 mm. through at the base, pubescent with fawn-colored hair and ciliate at the apex along the margin between the broadly acute teeth, the latter also ciliate, not at all striate; corolla segments 6 mm. long, 3 mm. wide at the base, not striate outside but marked with darker streaks, otherwise smooth; staminal ring projecting 1 mm. above the calyx; filaments setiform; anthers linear, broader at the base; ovary turbinate but truncate or rounded at the base, conically narrowed into a thick yellow glossy style; stigmas punctiform. *Fruit* elliptical oblong in outline when young, with long style and sterile carpels; when mature, black and shining, 5 to 5.5 cm. long, 4 cm. wide, obovate, rounded at the apex, asymmetrical at the base (measurements not including the perianth); pericarp thin, 1 mm.; mesocarp traversed by numerous fine sinuous branched fibres; endocarp hard, woody, dark brown. *Seed* ovoid, distinctly pointed at the apex, broadest at the base, 3.5 cm. long, 27 mm. broad, embryo quite distant from the hilum (10 mm.) and situated on the upper surface of the seed. *Fruiting perianth* constricted at the throat, 5.5 cm. broad, 5 mm. high.

Habitat.—This species inhabits the windward slopes of Mauna Kea, the highest mountain in the Pacific, on the island of Hawaii at an elevation of 2000 to

3000 feet below Mana between Honokaa and Paauhau. The forest in this region has been practically destroyed; only a few individuals have survived. Now they are lone sentinels in open meadow land. It was discovered on March 17, 1920. The type is Rock No. 17348 in the College of Hawaii Herbarium.

Observations.—A species closely related to *Pritchardia eriostachya* Becc. but differing from it mainly in the very large fruits which are nearly the size of those of *Pritchardia Lowreyana* Rock, in the pubescent and ciliate flowers, in the larger panicle with thick stout horizontal branches. The woolliness is exactly as in *Pritchardia eriostachya* Becc. but of a fawn-color instead of salmon color. The spadix branches into three panicles instead of being simple. The leaves are not covered with nearly confluent lepidia, but the lower surface is dotted with elongate, slightly fringed, distantly spaced, hyaline lepidia, giving it an almost glabrous appearance. The fruits of this species are the second largest in size in the genus. The densely packed short panicle resembles more that of *Pritchardia lanigera*, but the hairiness of the panicle is different.

23. **PRITCHARDIA VISCOSA** Rock sp. n.

(Plates XV, B; XXIII, N)

Description.—A medium-sized palm, trunk 6-8 m. high, 45 cm. in diameter. *Leaves* large, of the size of those of *Pritchardia Hardyi*, stiff; leaf blade 100 cm. long from the ligule to the apex, coriaceous, the lower surface densely tomentose with appressed, greenish white, much fringed, contiguous lepidia; segments 60, the central ones 5 cm. wide at their place of disjunction, parted about 24 cm. into two, broad and bluntly acute points, glabrous above, pale green, the lower costae covered with a dirty greyish wool; ligule crescent-shaped, strongly apiculate; petioles 88 cm. long, 3.5 cm. wide near the ligule, 11 cm. broad at the base, covered beneath, in the lower half, with a dark rufous cottony substance. *Spadix* branching into three distinct panicles about 1 m. long, 4 cm. wide at the base; main peduncles 1 cm. in diameter; spathes tubular at the base, glabrous inside, and densely covered with a coarse reddish brown tomentum, turning whitish towards the apex of the spathes; panicle simple branched with erect terete branchlets, only the two lower branchlets again branching once or twice. Panicles about 15 cm. long from the branching base to the apex of the upper branchlets, coarsely yellowish white villose; floriferous branchlets 10 to 11 cm. long, viscous, strongly sinuate between the spirally alternate flowers, 2 to 3 mm. thick; bracteoles very short, subulate. *Flowers* (unopened) thickly viscous, shining as if varnished, 10 to 11 mm. long; calyx angular, broadest at the base and solid, 5 mm. wide, nearly 7 mm. long, urceolate, narrowing towards the apex, not at all striate, the points short and sharp. Corolla shorter than the calyx, at least in the bud, the segments linear-oblong, 7 to 8 mm. long, 3 mm. wide, acute at the apex, inconspicuously ribbed; staminal ring protruding slightly beyond the calyx; filaments filiform, broader at the base; anthers attached at their lower third, elongate; ovary subtruncate; style sulcate and viscous; stigmas punctiform. Fruit ellipsoid-pear-shaped, large, nearly 4 cm. long, 2.5 cm. in diameter, rounded above, but sharply apiculate by the remains of the abortive carpels, thickest in the upper third, thence narrowing to a thickish base; pericarp 2.5 mm. thick, the basal part

solid; mesocarp permeated by many fibers; endocarp very thin, yellowish-white, shining. *Seed* ovoid, acute at the apex, the hilum oblong. *Fruiting perianth*, constricted at the apex; staminal ring and filaments persistent, spreading, 7 mm. broad.

Habitat.—Kauai, one mile north of Summit Camp and two miles east of Pole Line Trail, elevation 2000 feet, in Kalihiwai Valley, windward side of the island; flowering and fruiting, January, 1920. Rock No. 17295; type in the College of Hawaii Herbarium.

Observations.—A very distinct species, and the only one with a decidedly viscous inflorescence, calyx, and corolla. In the branching of the panicle it resembles *Pritchardia Hardyi*; but the spadix is much shorter. The flowers resemble those of *Pr. Rockiana*, while the fruits are quite singular, being ellipsoid-pear-shaped. The other three species now known from Kauai are closely related, while the present one, the fourth so far known from that island, stands quite by itself; it is one of the most interesting species so far found in these islands, although it is related to *Pr. Rockiana*.

24. **PRITCHARDIA LANIGERA** Becc. Malesia, III, 298, t. XXXVIII. f. 1-3; and in Webbia II. (1907) 203; and IV (1913), 209, 231; Rock, Indig. Trees Haw. Isls. (1913) 103, Pl. 32.

Pr. Gaudichaudii (non H. Wendl.) Hillebr. Fl. Haw. Isls. (1888) 450 (in part).

Washingtonia lanigera O. Kuntze, Rev. Gen. Pl. II (1891) 737.

Eupritchardia lanigera O. Kuntze, Rev. Gen. Pl. III. 2 (1898) 323.

(Plate XVII, A)

Description.—It is a rather robust palm with a very straight trunk, about 5 m. high and from 30 to 50 cm. in diameter, and with a beautiful head of large leaves. The *leaf blade* measures about 1 m. from the ligula to the apex, is of a thickish and tough structure; its lower surface looks glabrous, but, in fact, is closely dotted with small, appressed, orbicular or oblong, scale-like lepidia; the central segments are about 6 cm. broad at their disjunction places, and are parted, not very deeply into two gradually, finely acuminate, rigid (non-drooping) points. Petioles about as long as the blades, covered (apparently on both surfaces) with a copious floccose, grayish, amianth-like, indumentum, which extends to the base of the blades. *Spadices* apparently shorter than the petioles (in one specimen, perhaps not entire, about 40 cm. long) composed of a small panicle borne on a rather short, outwardly curved, peduncular part; the spathes are covered with the same kind of tomentum (more or less deciduous by age) as the petioles, are tubular in their basal part, and expand above into a lanceolate boat-shaped, acuminate, rigid chartaceous blade, which envelopes completely the panicle. The *flowering panicle* is ovate-thyrsoïd, 10-12 cm. long, slightly shorter than the spathes, dense, composed of a few 2-3 partite branches in its lower part, and of simple floriferous branchlets elsewhere; the latter are 4-8 cm. long, relatively

thick, about 4-5 mm. through, permanently clothed with a dense tomentum of rather long, ruffled, light-colored hairs, are somewhat angular and sinuous and marked with rather conspicuous, irregularly spirally alternate notches for the insertion of the flowers. The bracteole existing at the base of every flower is inconspicuous, being hidden by hair. *Flowers* (unopened) 10-11 mm. long, 4-5.5 mm. through in their lower part, slightly narrowed above to a conical, obtusely trigonous, acute point; calyx glabrous subovate urceolate, not veined, of a thickish hard structure, shortly solid at the base, slightly restrained at the mouth, and with 3 rather acute teeth; corolla not quite twice as long as the calyx, the segments elongate-triangular, acute, marked externally by 7 explanate ribs separated by narrow furrows; staminal ring slightly protruding beyond the calyx; filaments subulate from a broad base, remaining erect after the anthesis; anthers linear-sagittate; ovary turbinate, strongly sculptured above, and conically narrowed into a trigonous, sulcate, thickish style. *Fruit* apparently ovoid and relatively large (not seen mature).

Habitat.—First discovered by Mr. J. Lydgate on the Kohala Ridge on the island of Hawaii; collected again July, 1910, by Professor Rock (with flowers only) in the classical locality, above Awini, at about 1000 m. elevation, in a dense tropical rain forest (Rock No. 8820).

Observations.—In the densely hirsute floriferous branchlets it approaches *Pr. arecina* and *Pr. eriostachya*. From the first it differs in the leaf blade which is apparently glabrous underneath, but sprinkled really with minute, punctiform lepidia; whereas in *Pr. arecina*, the lower surface is appressedly subaureous-tomentose, and in *Pr. eriostachya*, is covered with relatively large, hyaline, nearly confluent, scale-like lepidia.

Lydgate's specimen, which fixes the type, is accompanied in the Berlin Herbarium by two immature fruits, ovoid, acute, about 3 cm. long, and 18-19 mm. through.

NOTE BY JOSEPH F. ROCK.

Pritchardia lanigera Becc. has been found by me in the mountains back of Waimea, Hawaii, on the flat swampy plateau at an elevation of about 4000 feet; there it is a palm with a stout trunk and very rigid leaves with non-drooping segments; the spadix is usually simple, but only in one instance did I come across a second very small panicle developed. The mature fruits of *Pr. lanigera* Becc. are as yet unknown, but from old remnants of fruits found on the ground beneath the palms, and from germinated, and growing ones it can be seen that they are not so large as those of *Pr. montis-kea* Rock, to which the species is also related. *Pritchardia lanigera* is evidently scattered throughout the Kohala mountains; on the high plateau back of Waimea it grows among stunted bog vegetation in sphagnum moss, with *Metrosideros*, *Clermontia parviflora*, *Broussaisia*, etc. The trunk is usually not more than 20 feet in height. Unfortunately only one of the many palms of this species examined had flowering panicles and

one had three green fruits adhering to an otherwise bare panicle. The largest of these fruits is obovoid, about 28 mm. long and about 20 mm. in diameter; the seed was still soft and easily cut, showing that the fruit was quite immature. Rock No. 17349 in the College of Hawaii Herbarium.

25. **PRITCHARDIA ERIOSTACHYA** Becc. in Webbia, IV. (1913) 209, 232; Rock, Indig. Trees Haw. Isls. (1913) 107, Pl. 33.

(Plates XVII, B; XXII, I)

Description.—A small tree, 6 to 7 m. high with a gray smooth trunk of 15 to 20 cm. in diameter (Rock). *Leaf blade* about 1 m. long from the ligula to the apex, of a thickish, rather coriaceous structure, subtomentose underneath from nearly confluent, hyaline, scale like, ciliate fringed lepidia; the lower costae also tomentose, at least near the base; central segments relatively short, 6 cm. broad at their disjunction places, and parted for the extent of about 10 cm. into two acuminate rigid points. *Petioles*, 75 cm. to 1 m. long, robust; *ligula* rounded, oblong. *Spadices* over 1 m. long, composed of a relatively small panicle at the end of a rather thick peduncular part. The spathes are clothed all over with a dense, rufous, nearly salmon-colored wool, are tubular in their lower part, and expand above into a lanceolate-acuminate ass's ear-like, chartaceous blade. The rachis and the panicle are also densely clothed with rufous wool; the panicle protrudes a little beyond the apices of the spathes, is erect during the anthesis, dense, ovate-thyrsoïd, 20-25 cm. long, and has a few short 3-4 partite branches in its basal part, and simple floriferous branchlets in the remainder; branchlets fastigiate, 6-7 cm. long, appearing thick from the dense wool with which they are covered, 6-7 mm. thick at the base, tapering above to acute apices, are slightly sinuous between the flowers which are spirally inserted all around on small projecting tubercles. *Floral bracts* broad and scarious at the base, with a long setiform, finally obsolete tip. *Flowers* (unopened) 10-11 mm. long; calyx cylindraceous, of a hard nearly woody texture, very shortly 3-toothed, 5 mm. long, 4 mm. through at the base, which is solid internally and excavate below, obsoletely veined only towards the teeth; corolla twice as long as the calyx, narrowed above and sub-acute; the segments very obsoletely marked by 6-7 narrow striae; staminal ring slightly projecting above the calyx; filaments setiform from a broad base; anthers linear-sagittate, blunt; ovary turbinate, deeply sculptured above, conically narrowed into a trigonous sulcate, thickish style; stigmas punctiform. The *fruit*, when still young, is obovate, rounded above, and apiculate from the rather conspicuous remains of the sterile carpels and style; it narrows from about the middle to a rather acute base; when thoroughly mature, it is ovoid-elliptical, or slightly obovoid, 3.5-4 cm. long (including the perianth), and 26-28 mm. through; the whole pericarp is 2.5-3 mm. thick, thicker at the base; mesocarp grumous, traversed by extremely fine fibers; endocarp very thinly woody, brittle. *Seed* very broadly ovoid, rounded at both ends. *Fruiting perianth* callous, depressedly pedicelliform, 6 mm. broad, 4 mm. high.

Habitat.—Discovered in January, 1912, by Professor Rock on Hawaii, on the southern slopes of the active volcano, Mauna Loa, and in the dense rain

forests of Naalehu, district of Kau, at an elevation of about 1000 m. (Rock No. 10004).

Observations.—A species very distinct by the copious and peculiarly colored wool that covers every part of the spadix (rachis, spathes, and floriferous branchlets); by the leaf-blade closely scaly-subtomentose underneath, with the segments not deeply parted into two short acuminate, non-drooping points; by the panicle having fastigiate thickish, woolly floriferous branchlets, and carried on a rather long and thick, peduncular part; and by the rather large ovoid fruit. It is not closely related to any other species, although resembling *P. lanigera* and *P. arecina*, in the dense hairy covering of the floriferous branchlets. The fruit represented in Webbia 1. c. fig. 17 *a-b* had not yet acquired its complete development.

26. **PRITCHARDIA ERIOPHORA** Becc. in Webbia, IV. (1913) 209, 235 f. 17 *c, d.*; Rock, Indig. Trees Haw. Isls. (1913) 105.

(Plates XVIII, *A, B*; XXIII, *Q*)

Description.—A palm 12 m. or more high with a slender trunk (Rock). Leaves small; leaf blade (in one specimen) 45 cm. long from the ligula to the apex, of a thickish, rather coriaceous structure; the lower surface tomentose from confluent, appressed, much fringed lepidia, of a light yellow, nearly golden, color in newly expanded leaves, grayish in the old ones; the segments, apparently are not very numerous (perhaps about 45); the central ones, 3.5 cm. broad at their disjunction places, deeply parted into two acuminate, rigid, nearly pungent points. Petioles short, about as long or even a little shorter than the blades. *Spadix* relatively short, 40-45 cm. long; spathes tubular in their lower part, and gradually expanded above into an elongate, lanceolate, acuminate, ass's ear-like, at first rigid-chartaceous, but later slashed blade; every part of the spadix, spathes and panicle is, like the petioles, very densely and copiously covered with a compact mass of very soft, rufous, cottony hairiness; the panicle is short, twice branched in its lower part and simply branched above, erect at first, and with branches and flowers almost hidden by the peculiar, very dense, fluffy clothing described above; when fructiferous, the panicle is recurved; the branchlets in age remain partially denuded and appear 2-5 cm. long, slender, 1-1.5 mm. through, zigzag sinuous. *Flowers* spirally alternate, seated on small projecting tubercles; when unopened, are 8-8.5 mm. long, 4 mm. through, oblong, not narrowed above, and obtusely apiculate; calyx cyathiform-campanulate, distinctly striately veined, glabrous, 3-toothed, the small teeth slightly hairy penicillate at apex; corolla twice as long as the calyx, the segments oblong subrectangular or with nearly parallel sides, strongly striate-costulate outside; staminal ring somewhat protruding beyond the calyx; filaments subulate from slightly broadened bases; anthers linear-oblong, rounded at apex; ovary turbinate, strongly sculptured above, and conically narrowed into a trigonous, sulcate, thickish style; stigmata punctiform. *Fruit* usually slightly asymmetrical, narrowly elliptical or thickly fusiform and subacuminate, being widest in the middle and tapering, about equally, in both directions, acute at the base, and apiculate by the remains of the abortive carpels and style; when mature, shiny black, 2.5-3 cm. long, 12-13 mm.

through; whole pericarp 1.5 mm. thick (dry) somewhat thicker at both ends, especially at the base; mesocarp very scanty, and with several longitudinal fibers; endocarp thinly woody, brittle. *Seed*, ovoid, 15 mm. long, 9 mm. through, conical and rather acute at apex, slightly more convex near the raphe than on the opposite side, marked at about the middle of the lateral faces with only one vascular branch of the raphe; hilum elliptical; integument slightly thickened on the raphe side; embryo nearly basal. *Fruiting perianth* campanulate, with the tube of the corolla and staminal ring persistent, and with the remains of the filaments erect.

Habitat.—Discovered in the year 1911 by Mr. Gerrit P. Wilder in the forest swamps of Halemanu in the central plateau of the island of Kauai. Professor Rock sent me the specimens from which the description above is derived (Rock No. 8846).

The typical *Pritchardia eriophora* Becc. was collected by Professor Rock when in company with Mr. Eric Knudsen and Mr. H. P. Agee, on the highest ridge, called Kaunuohua, near Kalalau, Kauai, at an elevation of 4200 feet; several individuals were observed, and the tallest one, measuring about 45 feet in height, was photographed: Rock No. 17319 in the College of Hawaii Herbarium.

Observations.—One of the smallest species, but very characteristic, allied only to *Pr. minor*. It is distinguishable by the leaf blade, which is subaureous tomentose underneath; by the very abundant soft, fulvous, cottony tomentum that covers every part of the spadix; by the small panicles having primary branches divided into short floriferous slender branchlets, also very densely clothed with the same peculiar hair that covers the spathes and rachis, but deciduous in age; by the rather small flowers with cyathiform-campanulate, strongly striately-veined calyx; and by the small ellipsoidal subfusiform, conically acuminate fruit.

The fruit of this species represented in Webbia l. c. fig. 17, *c*, *d* is one-tenth smaller than natural size. From *Pr. minor* it differs especially in the smaller panicle, with less densely flowered and shorter floriferous branchlets, and in the shape of the fruit.

27. **PRITCHARDIA MINOR** Becc. in Webbia, III. (1910) 137, and IV. (1913) 210, 238, f. 17 e. f. g.; Rock, Indig. Trees Haw. Isls. (1913) 104.

(Plates XIX; XXIV, *S*)

Description.—Apparently of the dimensions of *Pr. eriophora*, but with somewhat larger leaves. *Leaf blade* 60-85 cm. long from the ligula to the apex, clothed underneath with a rather soft, gray-yellowish or nearly golden tomentum, composed of not very appressed, yet much fringed lepidia, central segments up to 6 cm. broad at their disjunction places, parted to the extent of 15-25 cm. into two very gradually acuminate, rigid points. Petiole apparently about as long as the blade, very densely cottony-tomentose on both sides. *Spadices* composed of

a rather large panicle, which is borne on an apparently short, peduncular part; the spathes are, as usual, tubular in their lower portion, and expand above into a lanceolate, very long, acuminate, rigid-chartaceous blade, and are very copiously clothed with a very soft, rufous wool; the rachis of the spadix and all branches of the panicle are also clothed with a similar wool, which, however, is partly deciduous in age. The fructiferous panicle (in one specimen) is about 30 cm. long, nearly twice branched in its lower part, and simply branched at apex only; the lower primary branches divide in as many as 10-12 secondary branches, of which the lowermost are again 2-3 partite; fructiferous branchlets 4-7 cm. long, when denuded by age of their cottony clothing are 1.5 mm. through at the base, terete, subtorulose and closely sinuous between the rather closely, spirally set flower-pulvinuli. *Flowers* apparently small, but none are available for dissection in the specimens at hand. *Fruit* ovoid-ellipsoidal or obovoid, 10-20 mm. long, 12-13 mm. through, somewhat narrowed, usually slightly sigmoidally, to the base, rounded above and apiculate, frequently obliquely, by the small remains of the abortive carpels and style; whole pericarp about 1 mm. thick; mesocarp very scanty, with a layer of rather broad fibers in its inner part; endocarp hard, relatively thick and with a short and broad obconical, acute base. *Seed* regularly ovate, rounded at both ends, 12 mm. long, 6 mm. broad. *Fruiting perianth* shortly pedicelliform-campanulate, with the tube of the corolla and the staminal ring spreading.

Habitat.—The fruits upon which this species was based were collected in March, 1909, by Professor Rock on Kauai in the swampy forest near Alakai, back of Halemanu. Leafy specimens with fruits, quite similar to those that represent the type, were collected again on Kauai, also by Rock, in October, 1911, in the forests of Kaholuamanu.

Observations.—I have derived the description above from the specimens collected at Kaholuamanu, but in regard to its fruits I have not noticed any difference from the typical ones from Halemanu. However, Professor Rock observes that the palm from Halemanu was quite 20-30 feet, (6-9 m.) in height, with a slender stem of about 10 cm. in diameter, and that the palm from Kaholuamanu had a shorter and thicker trunk, and the whole plant had not the slender aspect of that from Halemanu. *Pr. minor* has, like *Pr. criophora*, the leaf blade subaureous-tomentose underneath, and the similarly copious, soft woolly clothing, on every part of the spadix; it is distinguishable, however, by its larger and more branched panicle, with longer and more robust terete-subtorulose, floriferous branchlets, which have the flowers rather closely spirally arranged around them; and by the small ovate or subovate fruit. The fruits of this species represented in Webbia l. c. fig. *e*, *f*, *g*, are about one-tenth smaller than natural size. Fig. *e* represents the fruit of the type from Halemanu and figs. *f*, *g* from Kaholuamanu.

28. **PRITCHARDIA VUYLSTEKEANA** H. Wendl. in Revue Hort. 1883, 329 f. 59 (young plants); Gard. Chr. 1883 XIX. 693, f. 14; Becc. Malesia, III. 291; in Webbia II. (1907) 202 and IV. (1913) 216.

Washingtonia Vuylstekeana O. Kuntze, Rev. Gen. Pl. II. (1891) 737.

Eupritchardia Vuylstekeana O. Kuntze, Rev. Gen. Pl. III. (1898) 323.

Description.—Fruit oblong, 24 mm. long, and 20 mm. through, terminated by the slightly excentric remains of the abortive carpels. Seed 14 x 15 mm. The leaf from a plant cultivated at Herrenhausen has the blade one-third of a circle in outline, parted into about 50 segments; it is quite glabrous, and devoid of lepidia on the lower surface; the lower costae are also glabrous.

Habitat.—The nearly inaccessible islands of the Dangerous or Low Archipelago (Paumotu or Tuamotu) in oriental Polynesia. The first mention of this palm appeared in a notice of the horticultural establishment of Ch. Vuylsteke at Loochristi, near Ghent in Belgium.

It is cultivated in the hot houses of some gardens.

29. **PRITCHARDIA PERICULARUM** H. Wendl. in Horto Vuylstek; Revue Hort. 1883, 206; Becc. Malesia III. 292; in Webbia II. (1907) 202 and IV (1913) 217.

Washingtonia pericularum O. Kuntze, Rev. Gen. Pl. II. (1891) 737.

Eupritchardia pericularum O. Kuntze, Rev. Gen. Pl. III. (1898) 323.

Description.—Fruit nearly spherical, a little smaller than that of *Pr. Vuylstekeana*, 20 mm. long, and 18 mm. through, terminated by the excentric remains of the sterile carpels and style. Seed 12 x 13 mm. The leaves from plants cultivated at Herrenhausen are similar to those of *Pr. Vuylstekeana*, are quite glabrous, and devoid of lepidia on the lower surface.

Habitat.—With the preceding in the Dangerous Archipelago.

30. **PRITCHARDIA WRIGHTII** Becc. in Webbia, II. (1907) 203; in Pomona Journ. of Econ. Botany, III. Feb. 1913, 398, f. 160, 161, 162.

Colpothrinax Wrightii Gris. et Wendl. in Pl. Cub. Wright No. 3964; H. Wendl. in Kerch. Palm, 241; Sauv. Fl. Cub. No. 2382.

(Plate I, B; fig. 1, I a, b, c.)

Description.—A very curious palm with a trunk 10-12 m. high, smaller, and bottle shaped in its lower part or toward the middle, and very slender and cylindrical above. Leaves large; blade suborbicular in outline, broadly cuneate at the base, 1.50 m. long from the ligula to the apex, parted regularly nearly to the middle into very numerous segments (about 80 in one specimen), glossy above, finely and very appressedly tomentose underneath; the lower main costae equally tomentose; the tomentum is easily removable, and the surface appears then distinctly dotted with glandiform bodies, which, apparently, are the bases of the trichomes of which the tomentum is made; secondary nerves numerous; transverse veinlets obsolete; the lateral segments are deeply bifid, and the divisions gradually acuminate; the central segments are 3-3.5 cm. broad at their disjunction places, and biparted at apex to the extent of 3-5 cm. only. Petioles about as long as the blade, robust, 4 cm. broad at apex; ligula, thinly coriaceous, brittle,

crenate; rachis narrow, somewhat produced into the blade. *Spadices* short, composed of a loose panicle 20-25 cm. long at the end of an about as long or perhaps longer peduncular part; upper spathes (only two present in the specimen at hand) tubular in their lower part, expanded above into a concave ass's ear-like, lanceolate, acuminate, thinly coriaceous, rigid, outside, appressedly rusty, tomentose blade; the panicle at time of anthesis is spreading, or curved, and thrust out of the spathes; it has the rachis finely rusty tomentose, but is finally glabrous, and is loosely divided into few very spreading branches, of which the lower are 3-4 partite, and the upper simple; floriferous branchlets 12-16 mm. long, 2-3 mm. thick at the base, narrowed above, and subulate at apex, subterete, and nearly straight, being only very slightly sinuous between the floral pulvinuli, the latter superficial, furnished with a very minute subulate bract. *Flowers* irregularly spirally inserted in the lower part of the branchlets, alternate and subbifarious above, apparently somewhat fleshy, small, 7 mm. long (unopened) and 2-5 mm. broad at the base, and narrowed above to a rather acute apex; calyx cyathiform-campanulate, tricostulate-subtrigonus, of a fleshy subcoriaceous structure, internally solid at the base, and with three minute teeth at the otherwise truncate mouth; corolla twice as long as the calyx, the segments semi-ovate-triangular, acute, inserted just outside the mouth of the calyx, spreading during the anthesis, and soon deciduous; staminal ring, protruding above the calyx, crowned by six narrowly-triangular, acuminate filaments; anthers linear-sagittate, obtuse and slightly emarginate at apex; ovary turbinate, sculptured above and rather suddenly narrowed into a trigonous, sulcate, rather slender style; stigmas punctiform. *Fruit*, when young, obovoid, narrowed a little at the base, and with the small remains of the sterile carpels at apex; when thoroughly mature, globose, 15-18 mm. in diameter; whole pericarp of the young fruit thin, not quite 2 mm. thick; mesocarp scanty, parenchymatous, slightly fibrous; endocarp easily separating from the mesocarp, very thinly woody; it forms a fragile kernel to the free seed, is globose, frequently slightly irregular, 11-14 mm. in diameter, and very obtusely caudiculate. *Seed* globose 8-10 mm. in diam., erect, with a very dark brown dull surface; hilum small, orbicular; the raphe extends all along one side, and has no visible vascular branches; the integument is somewhat thicker on the raphe side than elsewhere, and enwraps the albumen on that side, but does not penetrate into its substance. Albumen homogeneous, hard, nearly horny; embryo placed about midway of the antiraphe side. *Fruiting perianth* persistent; the hardened calyx forms a distinct terete pedicel and upon it persist the remains of the corolla tube, and of the staminal ring with its recurved filaments.

Habitat.—Cuba and the S. West coast of the Isla de Pinos. In Cuba: *Plantae Cubanae Wrightianae* No. 3964 (Berlin Herbarium); at Herradura Prov. of Pinar del Rio, *Van Hermann* No. 5392, Herb. de Cuba. Estacion central Agronomica (Herb. Beccari and Berlin). On the Isla de Pinos at Nueva Gerona, *W. T. Curtiss*, West Ind. Pl. No. 364 (Herb. de Candolle, Berlin and Munich).

Observations.—It is a most singular palm owing especially to the peculiar appearance of its stem, which, being swollen in its lower portion, looks like an enormous bottle, tapering above into a long neck. I have already pointed out

in "Webbia," (1907) that, as I have not been able to discover any special character by which *Colpotherinax* could be generically separated from the Polynesian species of *Pritchardia*, I have been obliged to reduce it to the latter. I may add that *P. Wrightii* so much resembles its Polynesian parents, even to the peculiar clothing of the lower surface of the leaf-blade, as to leave no doubt of the common origin. This is, I think, one of the most important facts of the geographical distribution of palms.

The principal character that distinguishes *Pr. Wrightii* from its Polynesian relatives consists in its fleshy flowers; moreover, the spadices have the panicles enveloped by two large spathes only; the seed has the thickening of the integument on the raphe side rather pronounced; the surface of the seed is not marked by visible vascular branches, and the embryo is somewhat remotely placed from the base, or almost in the middle of the raphe side.

In the Polynesian *Pritchardias* the flowers are always of a very hard, nearly woody structure; the spadices have the panicles enwrapped by several imbricating spathes; the thickening of the integument is very slight; the embryo is placed very near to the hilum; and the raphe has on each side 1-3 distinct vascular branches. (In *Pritchardia montis-kea* Rock the embryo is 10 mm. distant from the hilum while in all other Polynesian species the embryo is immediately above the hilum.—J. F. Rock.)

31. PRITCHARDIA KAHANAE Rock et Caum sp. n.⁹

Description.—Trunk 1.5-2 m high, 15 cm. in diameter, decidedly bulbous at the base, 25 cm. in diameter (E. L. Caum). Leaves very rigid, robust; the blade 85 cm. long from the apex of the ligule, segments 52, divided for 35 cm. (median segment), 5.5 cm. in width at their disjunction places; petiole 82 cm. long, 12.5-13 cm. wide at the base, 4.5 cm. wide at the ligule, dark green on the upper surface, covered densely below with silvery confluent lepidia; ligule low crescent-shaped. Spadix simple, about 43 cm. long, including the 12 cm. long panicle, the latter glabrous in flower and in fruit; floriferous branchlets simple, only the lower divided; flowers urceolate, reminding one of those of *Pr. Montis-Kea*, conical, broad at the base (5 mm. in diameter), constricted at the apex, glossy, smooth and puberulous, indistinctly striate near the bluntish teeth; staminal cup protruding one-third the length of the calyx; the filaments short and not spreading. Petals as long as the calyx. Fruit subglobose to globose, black and shining at maturity, about 4 cm. in diameter, rounded at both ends; exocarp thin, the finely fibrous branched mesocarp 4 mm. thick, endocarp thin, less than 1 mm. thick. Seed ovoid, acute at the apex, the embryo immediately above the hilum. Fruiting perianth callous, the remains of the staminal cup spreading.

⁹ Specimens of Nos. 31 and 32 were shown to Professor Rock while he was in Honolulu for a few days on his way from the Orient to Washington. As the monograph was already in press, the author considered it unwise to delay publication indefinitely in order to obtain photographs or to study field relations.—Ed.

Habitat.—Hawaiian Islands: Oahu, on the windward side of the crest of the Koolau ridge in Kahana Valley, near Puu Kaaumakua. Elevation about 2350 feet. (Collected by Messrs. E. L. Caum, G. A. McEldowney and H. S. Palmer on May 16, 1921. The type is No. 18001 in the herbarium of the Board of Agriculture and Forestry, Honolulu.

Observations.—This species, while related to *Pr. Martii*, differs considerably from it, especially in the globose fruit, thick, urceolate calyx and simple, small spadix.

32. PRITCHARDIA MARTIOIDES Rock et Caum sp. n.⁹

Description.—Trunk 4–5 m. high, 15–17.5 cm. in diameter, of even width throughout, with semi-rigid, robust leaves. Petiole 100–110 cm. long, to the apex of the cuspidate ligule, 18–19 cm. wide at the base, 5 cm. wide at the apex; bright green and smooth above, fugaceously tomentose at the base beneath; ligule oblong, cuspidate; leaf-blade (mature) 105 cm. long, segments about 52, 5 cm. wide at their disjunction places, divided to a length of 34 cm. (median segment), with long filaments between the segments, later becoming deciduous; dark green above, covered beneath with confluent hyaline lepidia, of a silvery blue color; lepidia like those of *Pr. Martii*. Spadix simple, 55 cm. long when in fruit, 3.5 cm. wide at the base; panicle simple, 12 cm. long, the two lowest floriferous branchlets again dividing, fugaceously tomentose, floriferous branchlets 9–10 cm. long, 4 mm. thick; flowers arranged spirally; spathes ladle-shaped, 15 cm. long, acute, carinate at the back, with pale brown appressed paleae. Flowers, unopened, 11 cm. long, oblong, bluntly acute; calyx slightly narrowed at the base, glossy, indistinctly striate at the apex; teeth bluntly acute, ciliate; corolla slightly longer (7 mm. long), staminal cup protruding 2 mm., the filaments spreading, of even width and not spreading from a broad base; anthers reflexed at anthesis, linear, versatile; style trigonous, sulcate. Fruit (immature) slightly obovoid, at maturity distinctly oblong, 4.5 cm. long, 2.5–3 cm. in diameter, distinctly ridged, black, shining; exocarp thin, papery; mesocarp 6 mm. thick, finely fibrous, the fibres branching; endocarp bony, 1 mm. thick. Seed oblong, acute at the apex. *Fruiting perianth* subcylindrical.

Habitat.—Hawaiian Islands: Oahu, on the leeward side of the crest of the Koolau ridge near Puu Kaaumakua. Elevation about 2350 feet. Collected by Messrs. E. L. Caum, G. A. McEldowney and H. S. Palmer on May 16, 1921. The type is No. 18000 in the herbarium of the Board of Agriculture and Forestry, Honolulu.

Observations.—This handsome species is related to *Pritchardia Martii*, but differs from it in the very short simple spadix, fugaceously tomentose panicle, the shorter staminal cup, uniformly slender filaments, shorter corolla and ciliate calycine teeth. The fruit is decidedly oblong instead of subglobose.

IMPERFECTLY KNOWN SPECIES.

31. PRITCHARDIA AUREA Hort. Linden, Revue Hort. 1878, 186; Illustr. Hort. 1881, 32; Becc. in Webbia, II. 207.

I have seen, in the Berlin Herbarium, a few leaves of a palm, labelled with this name by H. Wendland, but differing somewhat from those of any other *Pritchardia* known to me, in the ligula terminating the petiole, which is transverse, or nearly horizontal, unequally lobate, and produced at the sides to sustain the outermost segments; also the blade has the base broadly cuneate; otherwise it is very similar to that of the generality of *Pritchardias*; its lower surface is sprinkled with small prominent subglandiform, pluricellular, yellowish bodies. I do not know the place of origin of this palm.



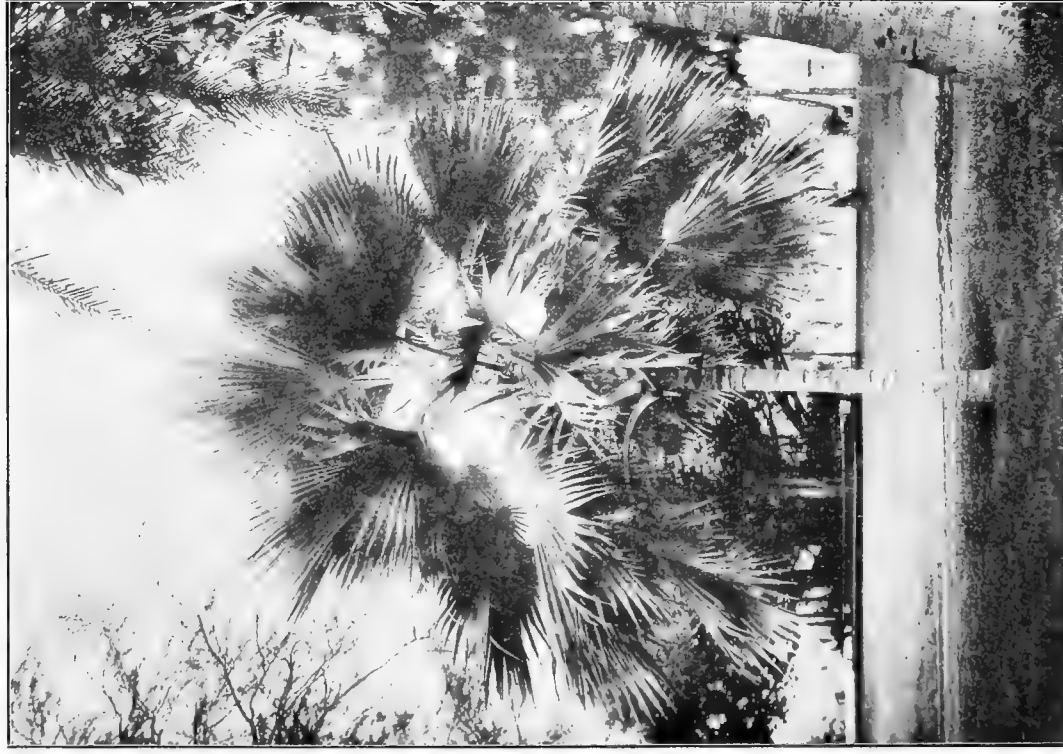


A, PRITCHARDIA THURSTONII, F. v. M.
ET DRUDE. CULTIVATED. KING-
STON, JAMAICA. (Photograph by
H. L. Lyon.)

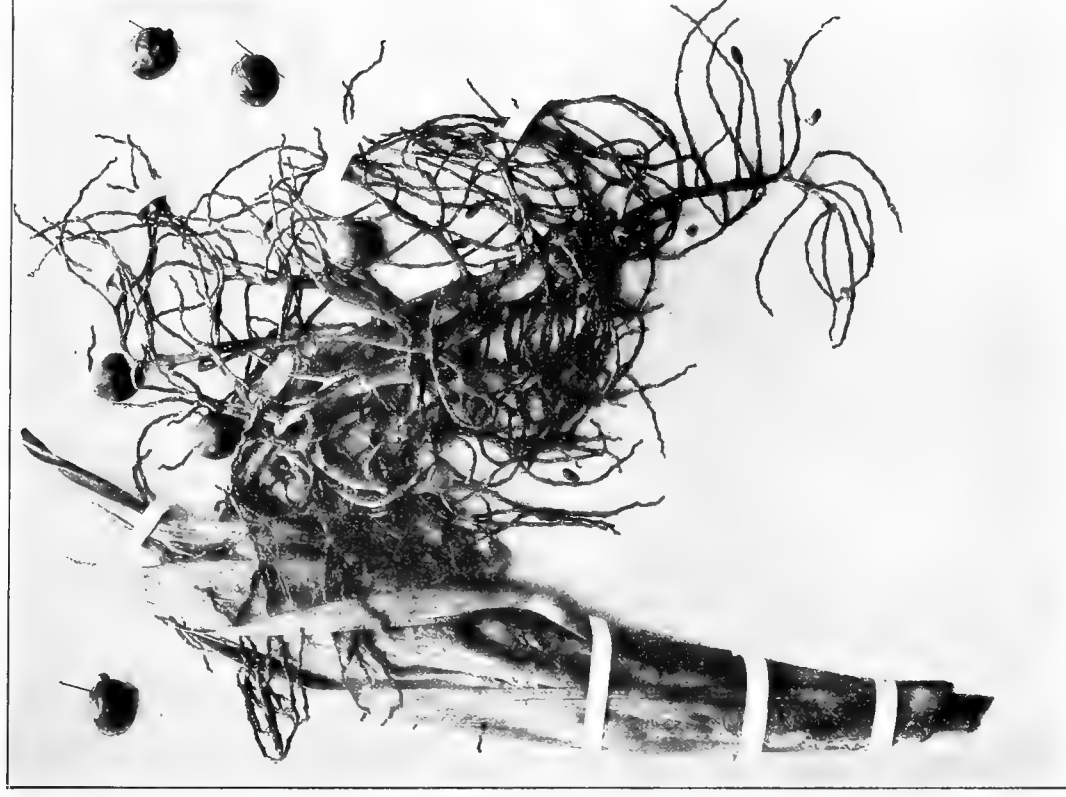


B, PRITCHARDIA WRIGHTII BECC. GROWING
WILD. CUBA. (Photograph by How-
ard.)





A, PRITCHARDIA HILLEBRANDI BECC. CULTIVATED.
KAPIOLANI PARK, OAHU.



B, PRITCHARDIA REMOTA BECC. FRUITING BRANCH.



A, *PRITCHARDIA AFFINIS* BECC. TREE AT KAOHĒ, SOUTH KONA, HAWAII. ELEVATION 1800 FEET.



B, *PRITCHARDIA AFFINIS* BECC. FRUITING BRANCH. (TYPE.)



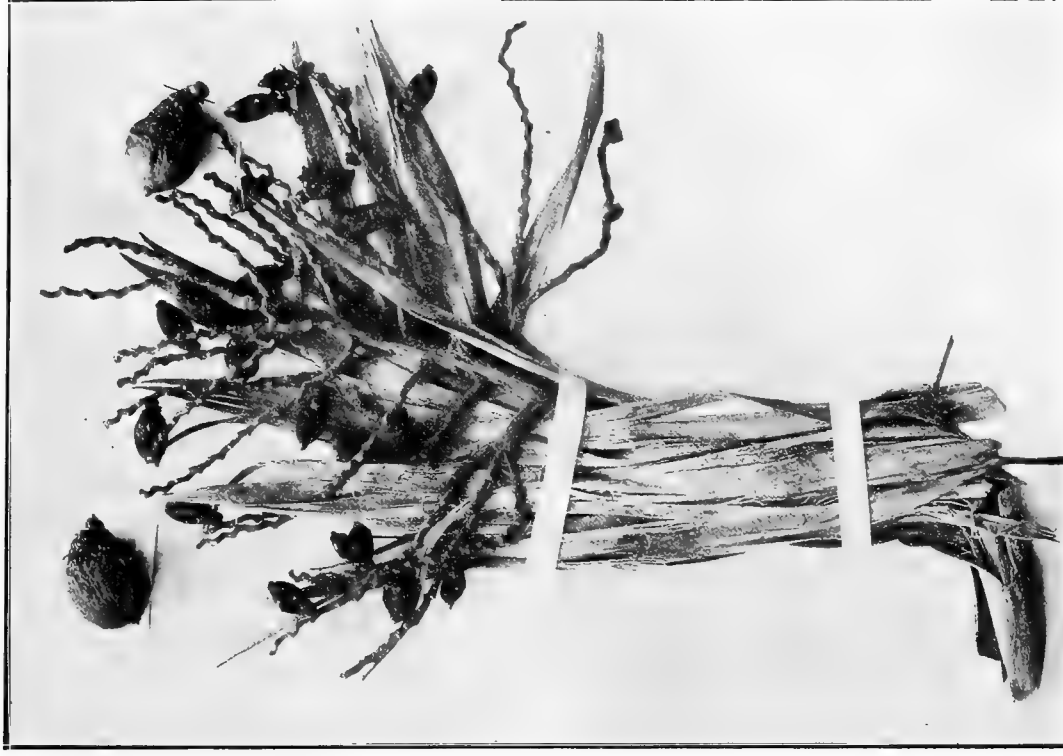
A, PRITCHARDIA AFFINIS VAR. HALOPHILA BECC.
FRUITING BRANCH.



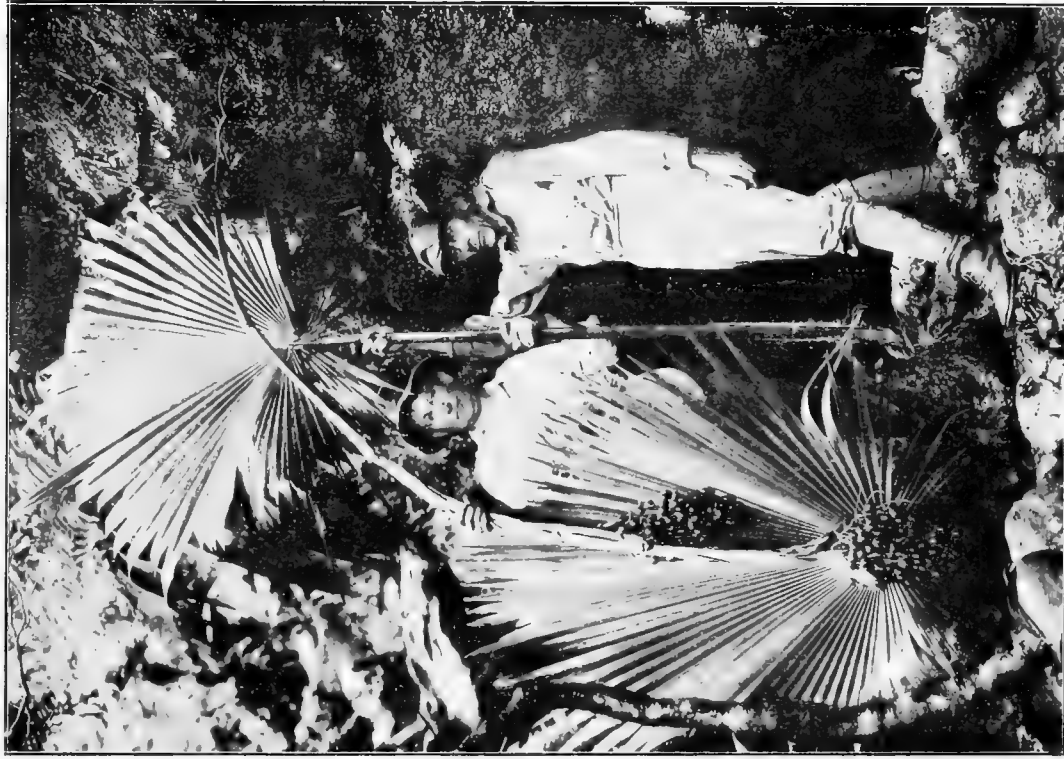
B, PRITCHARDIA AFFINIS VAR. RHOPALOCARPA BECC.
GROUNDS OF MRS. LANZ, HONOLULU. THE NATIVE
HABITAT SOUTH KONA, HAWAII.



A, PRITCHARDIA LANAIENSIS BECC. ET ROCK.
FRUITING BRANCH.



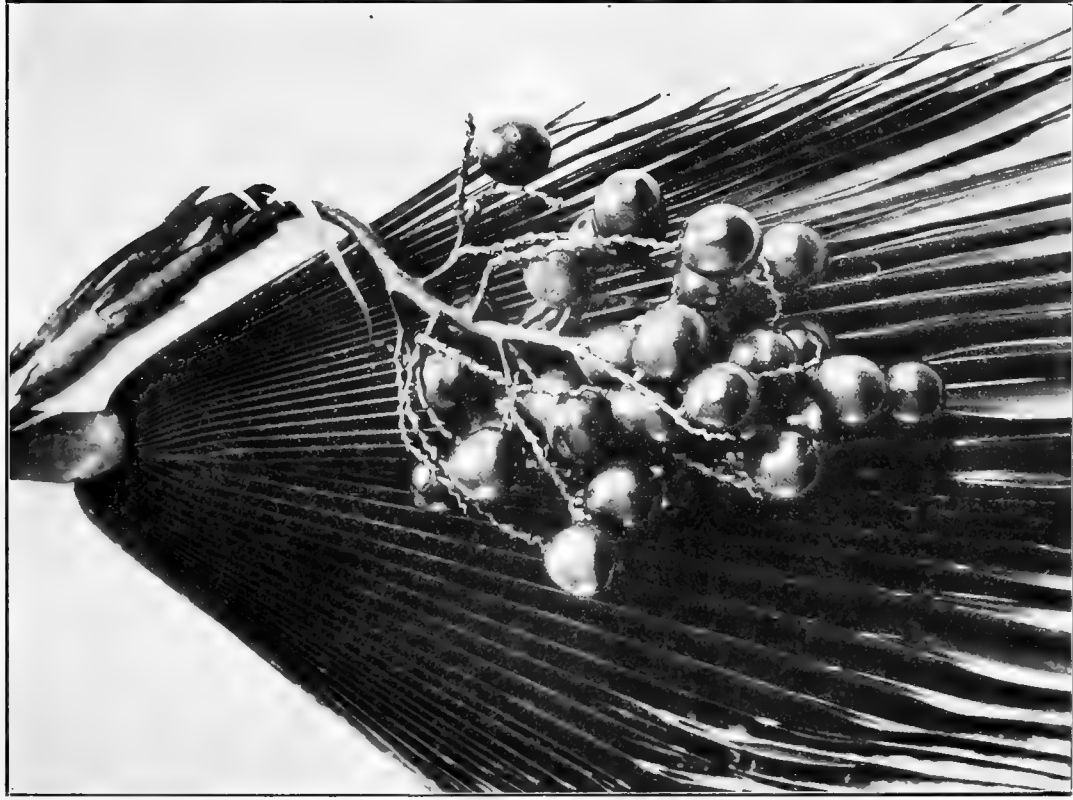
B, PRITCHARDIA ROCKIANA BECC. FRUITING BRANCH.



A, PRITCHARDIA KAALAE ROCK. TREE AT MAKALEHA VALLEY, OAHU (THE TYPE LOCALITY). ELEVATION ABOUT 1500 FEET.



B, PRITCHARDIA KAALAE ROCK. FRUITING BRANCH.



A, PRITCHARDIA MARTII H. WENDL. FRUITING BRANCH.



B, PRITCHARDIA BECCARIANA VAR. GIFFARDIANA BECC.
TREE IN FOREST ABOVE HILO, HAWAII. ELEVATION
ABOUT 2400 FEET.



A, PRITCHARDIA GAUDICHAUDII H. WENDL. TREE ON RIDGE
BETWEEN WAIHANAU AND WAIALEIA, MOLOKAI. ELEVATION
3000 FEET.



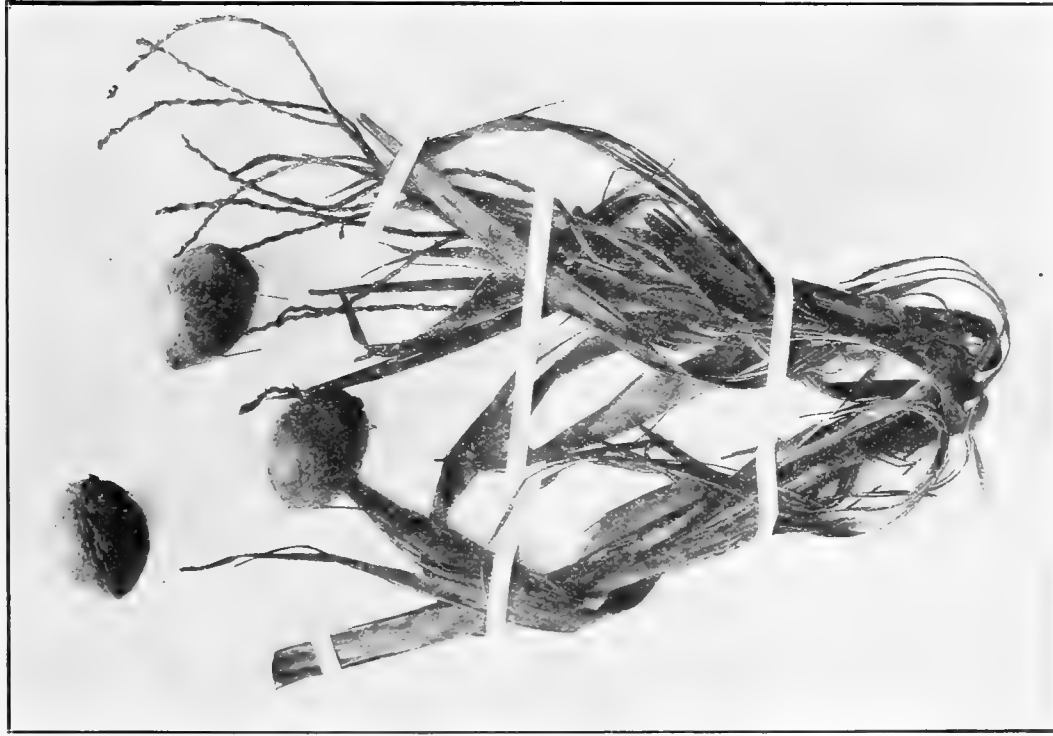
B, PRITCHARDIA GAUDICHAUDII H. WENDL. FRUITING BRANCH.



A, PRITCHARDIA FORBESIANA ROCK. TREE AT HONOKAHAU
GORGE, WEST MAUI. ELEVATION 4000 FEET.



B. PRITCHARDIA FORBESIANA ROCK. FRUITING BRANCH.



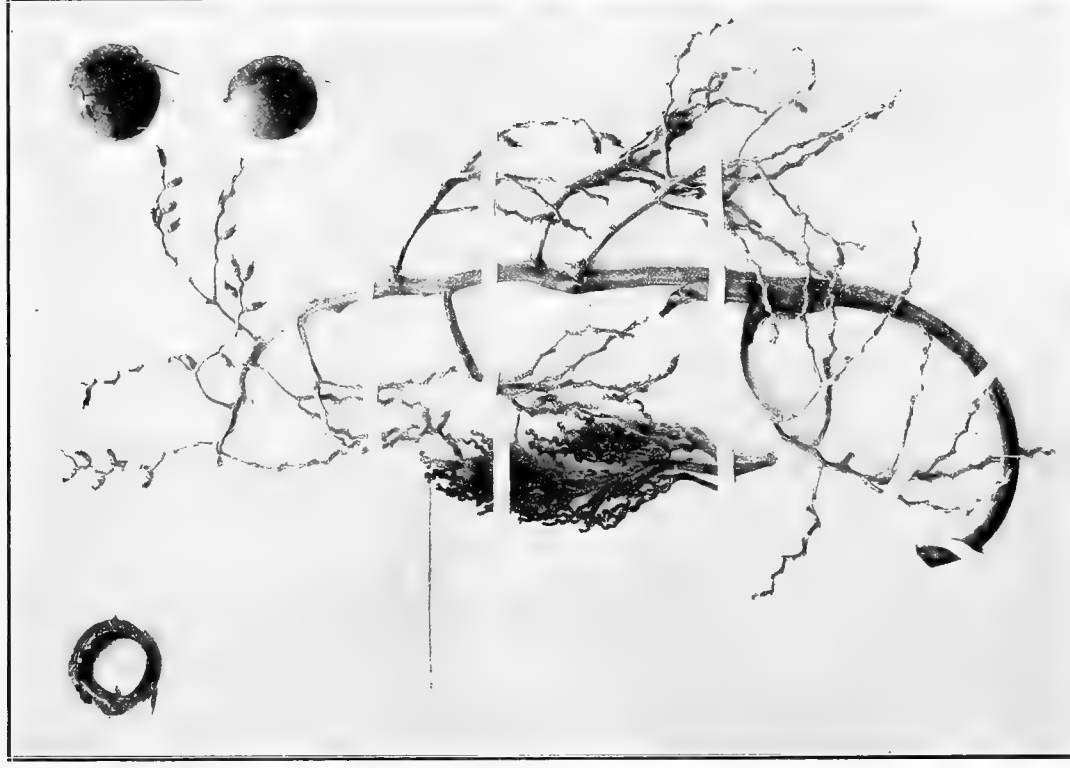
A, PRITCHARDIA LOWREYANA ROCK. FRUITING BRANCH.



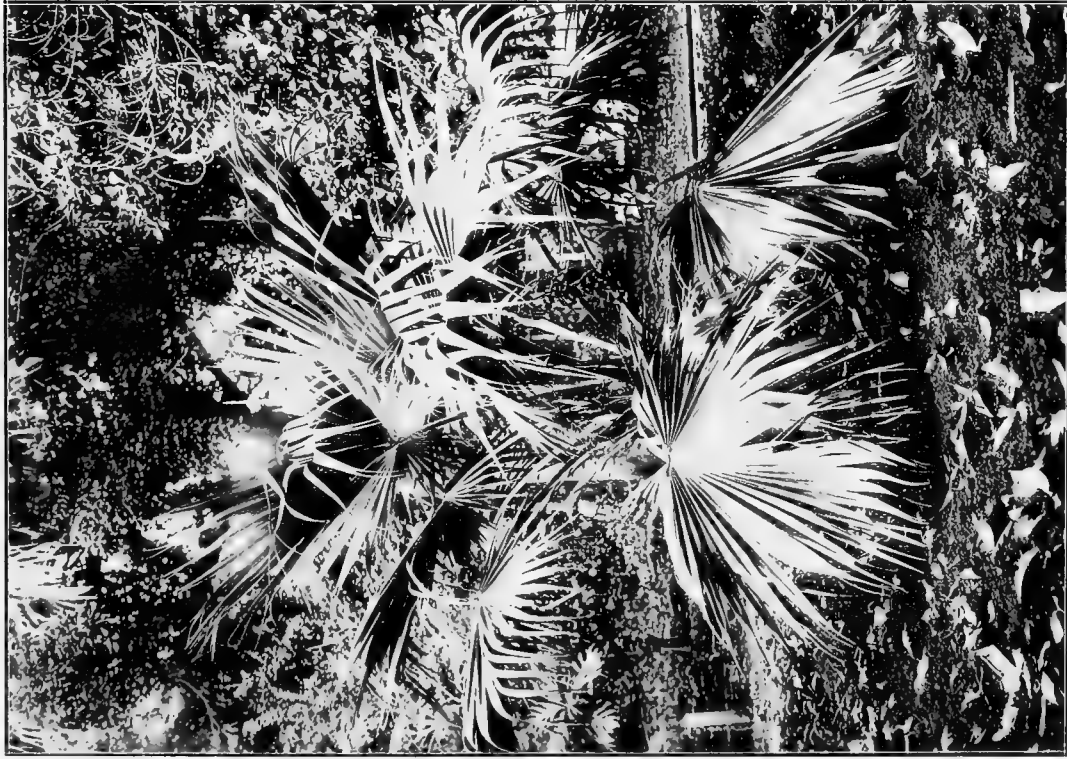
B, PRITCHARDIA LOWREYANA VAR. TURBINATA ROCK.
FRUITING BRANCH. (TYPE.)



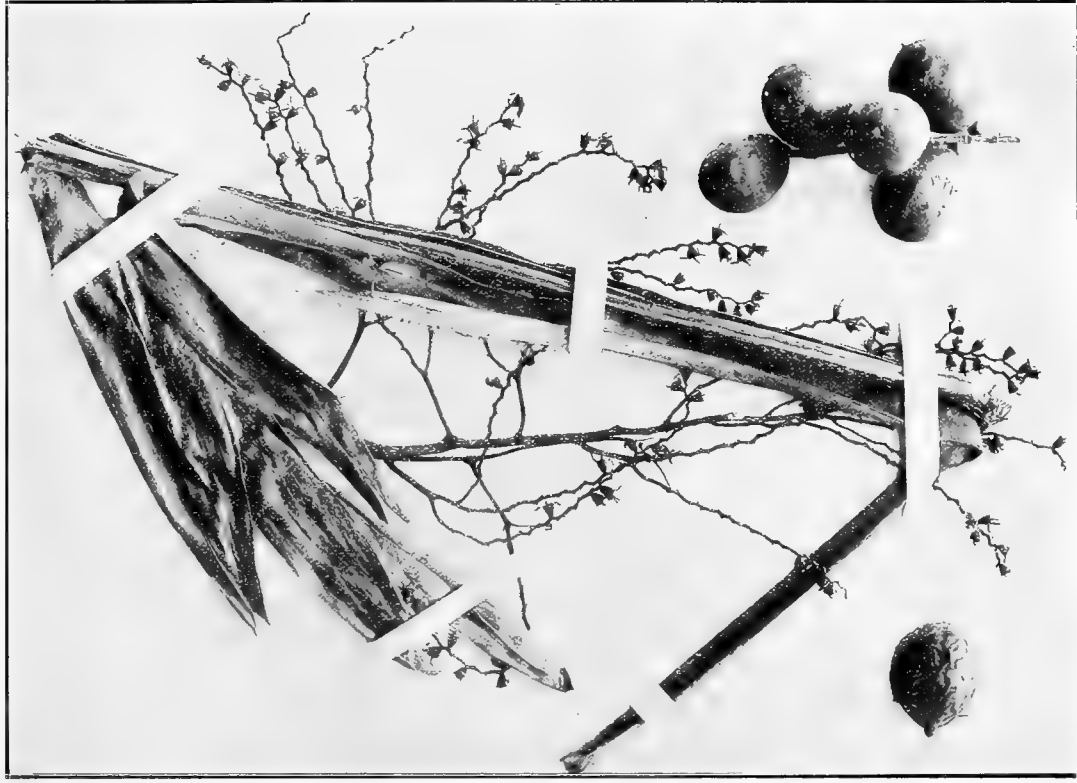
A, PRITCHARDIA BECCARIANA ROCK. TREE IN FOREST
NEAR GLENWOOD, HAWAII. ONE OF THE TALLEST
SPECIES OF PRITCHARDIA.



B, PRITCHARDIA BECCARIANA ROCK. FRUITING BRANCH.



A, PRITCHARDIA MACROCARPA LINDEN. CULTIVATED TREE.
(TYPE.) GROUNDS OF MRS. MARY E. FOSTER,
HONOLULU.



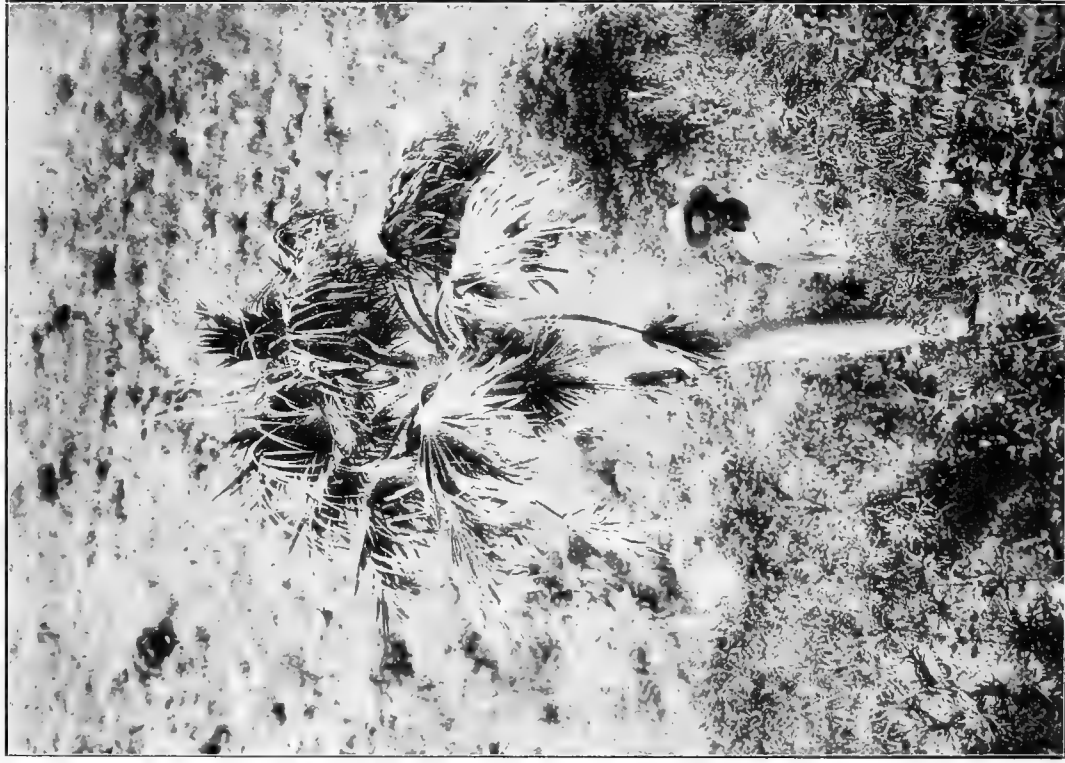
B, PRITCHARDIA MACROCARPA LINDEN. FRUITING BRANCH.



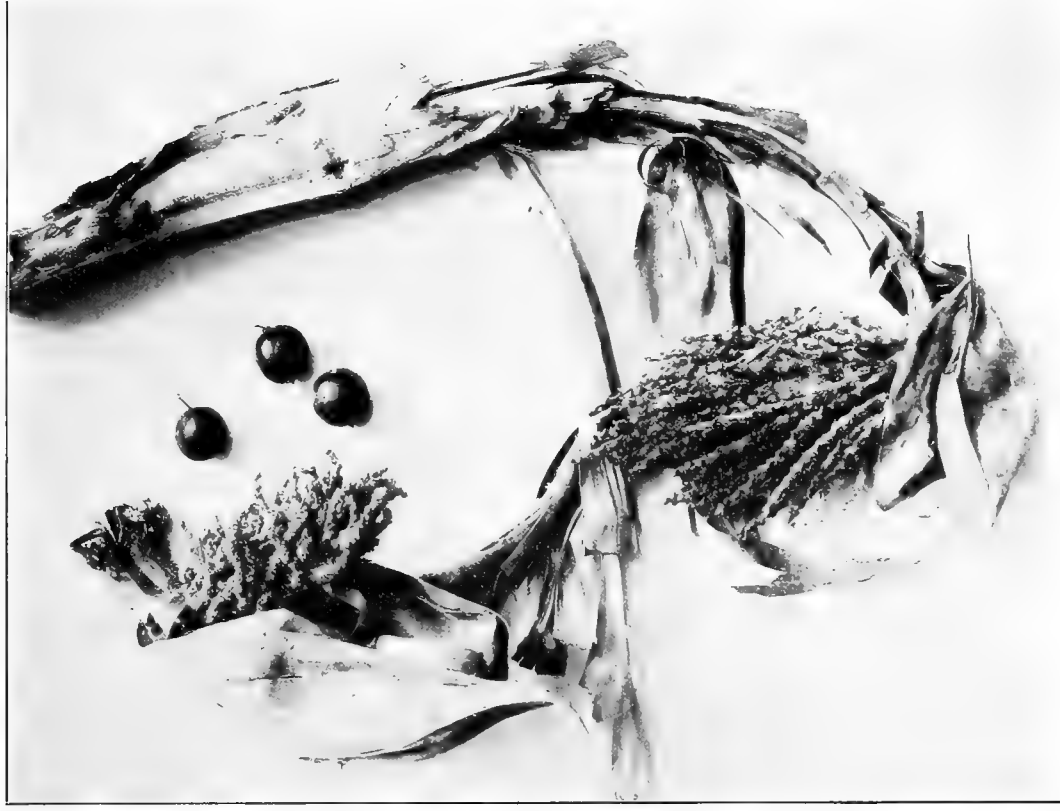
A, PRITCHARDIA HARDYI ROCK. TREE IN FOREST BACK OF
LIHUE, KAUAI. ELEVATION 1900 FEET.



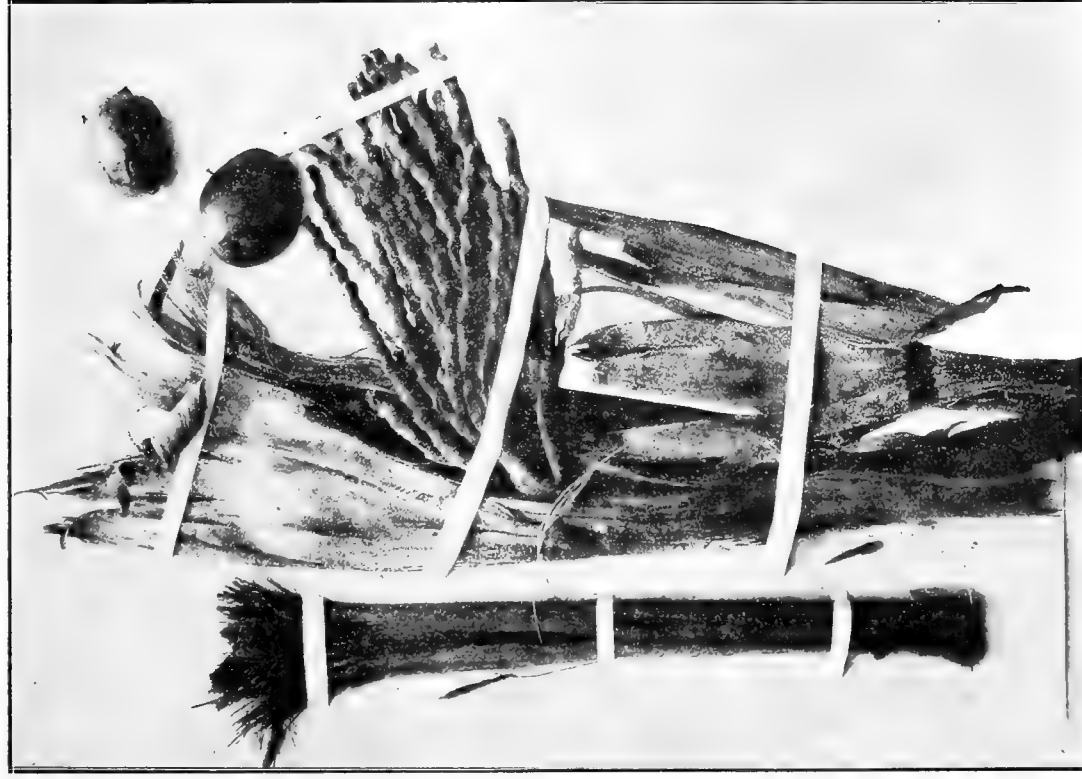
B, PRITCHARDIA HARDYI ROCK. FRUITING BRANCH.



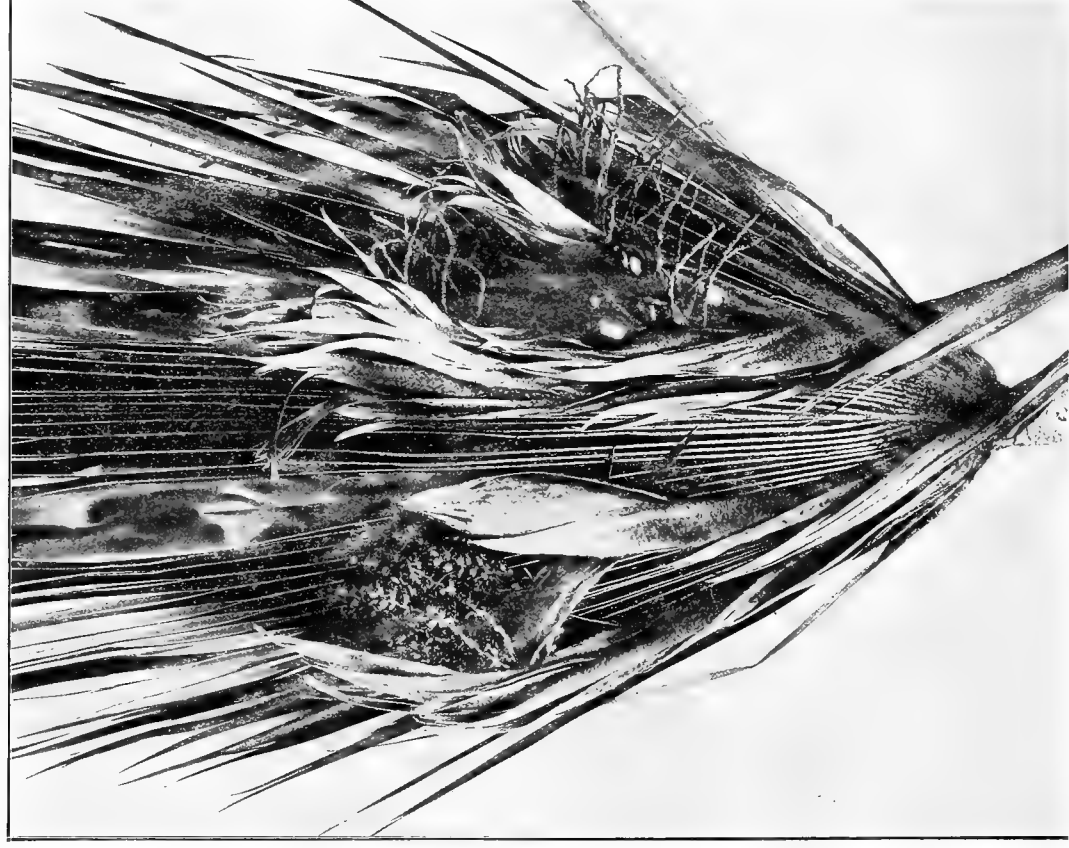
A, PRITCHARDIA MUNROI ROCK. TREE AT PUAKOOLAU-KAMOLO, MOLOKAI. (TYPE.) ELEVATION 2000 FEET.



B, PRITCHARDIA MUNROI ROCK. FRUITING BRANCH. (TYPE.)



A, PRITCHARDIA ARECINA BECC. FRUITING BRANCH.



B, PRITCHARDIA VISCOSA ROCK. FRUITING BRANCH. (TYPE.)



A, PRITCHARDIA MONTIS-KEA ROCK. TREE ON THE WINDWARD SLOPES OF MAUNA KEA BETWEEN MANA AND HONOKAA. ELEVATION ABOUT 1800 FEET. CATTLE HAVE DESTROYED THE FOREST IN THIS REGION.

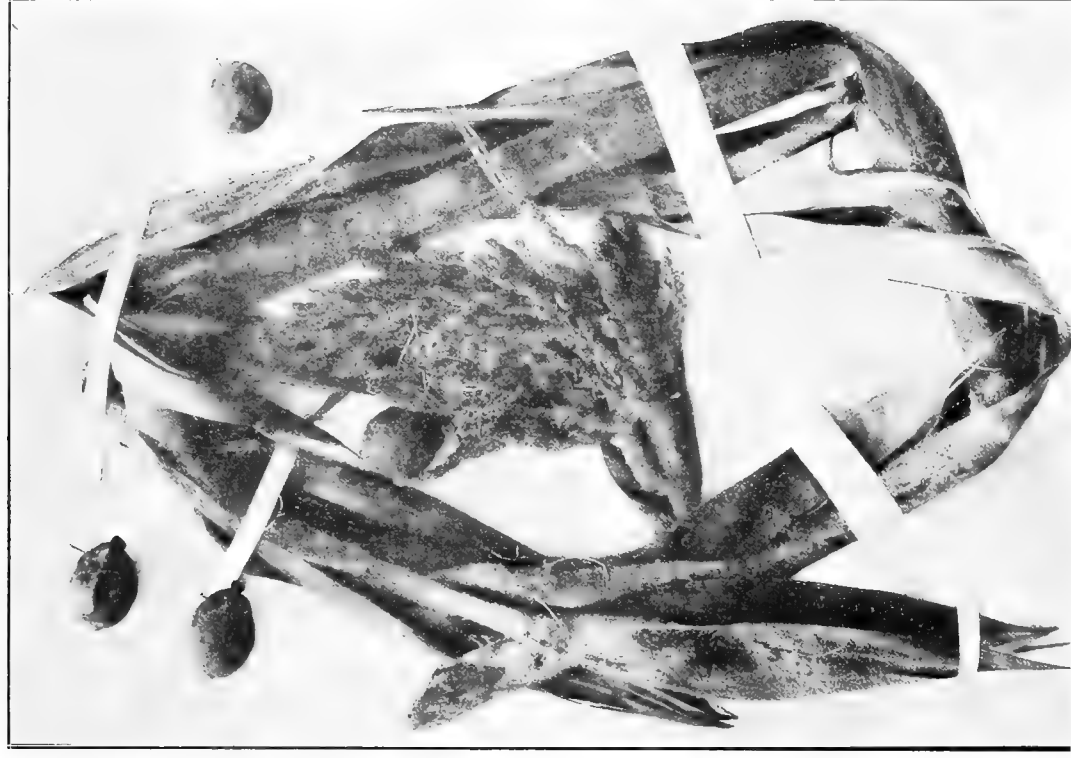


B, PRITCHARDIA MONTIS-KEA ROCK. FRUITING BRANCH.
(TYPE.)





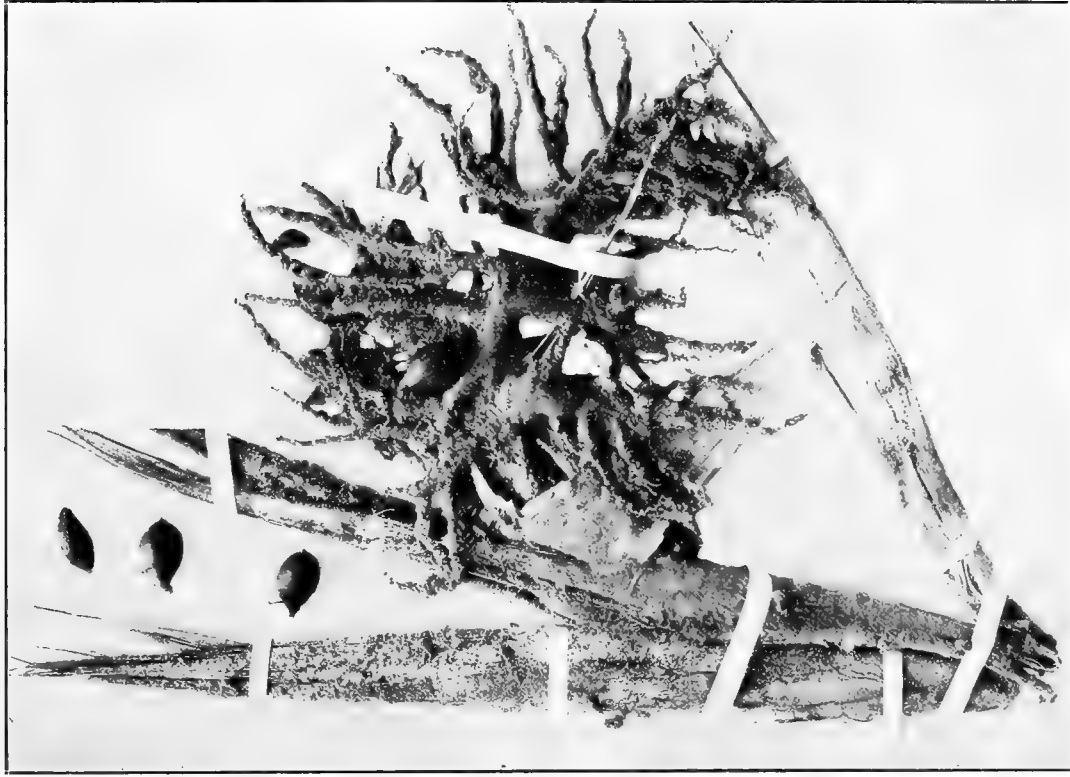
A, PRITCHARDIA LANIGERA BECC. FRUITING BRANCH.



B, PRITCHARDIA ERIOSTACHYA BECC. FRUITING BRANCH.



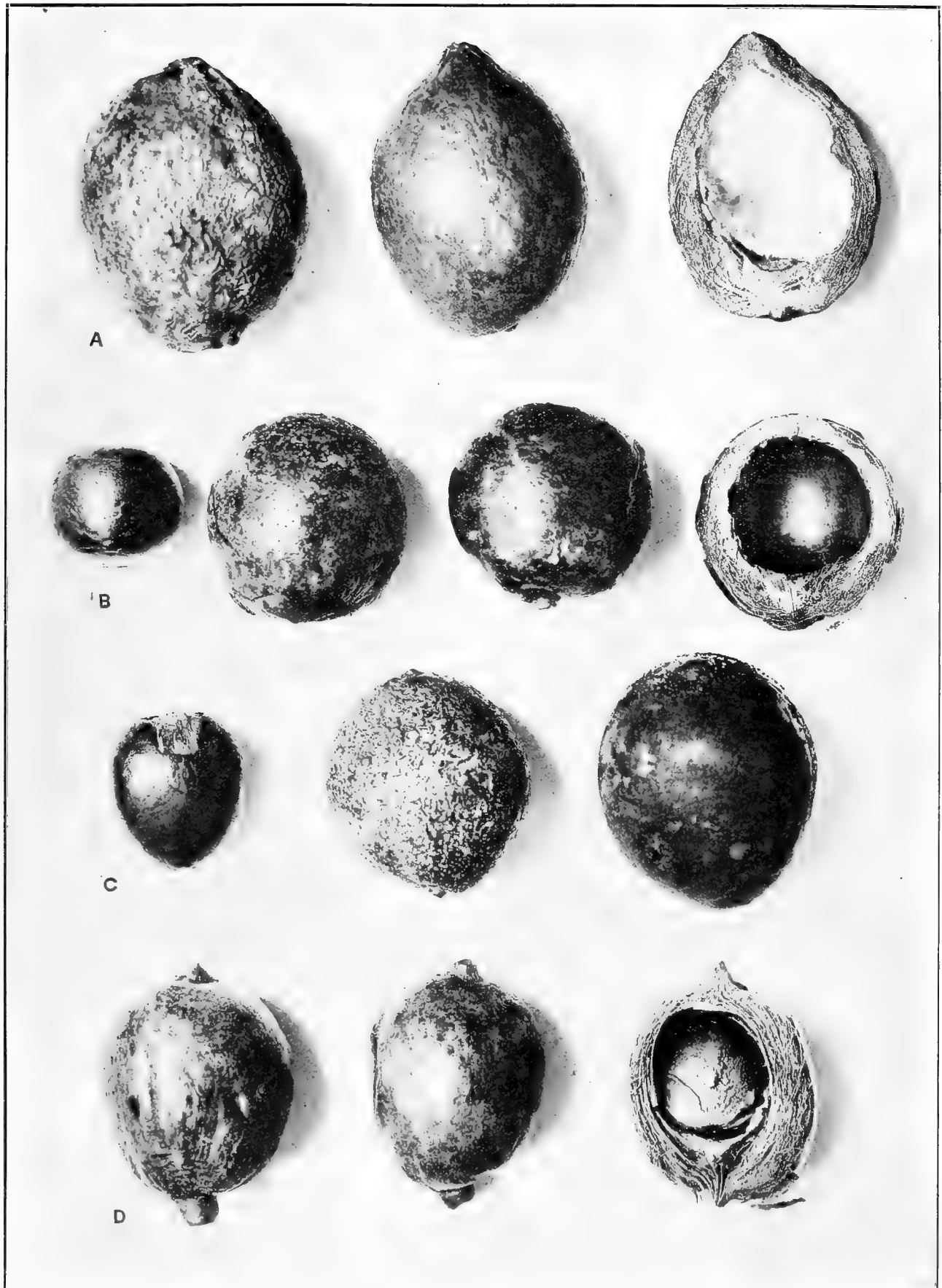
A, PRITCHARDIA ERIOPHORA BECC. TREE AT KAUNOAHAUA
NEAR KALALAU, KAUAI. ELEVATION 4200 FEET.



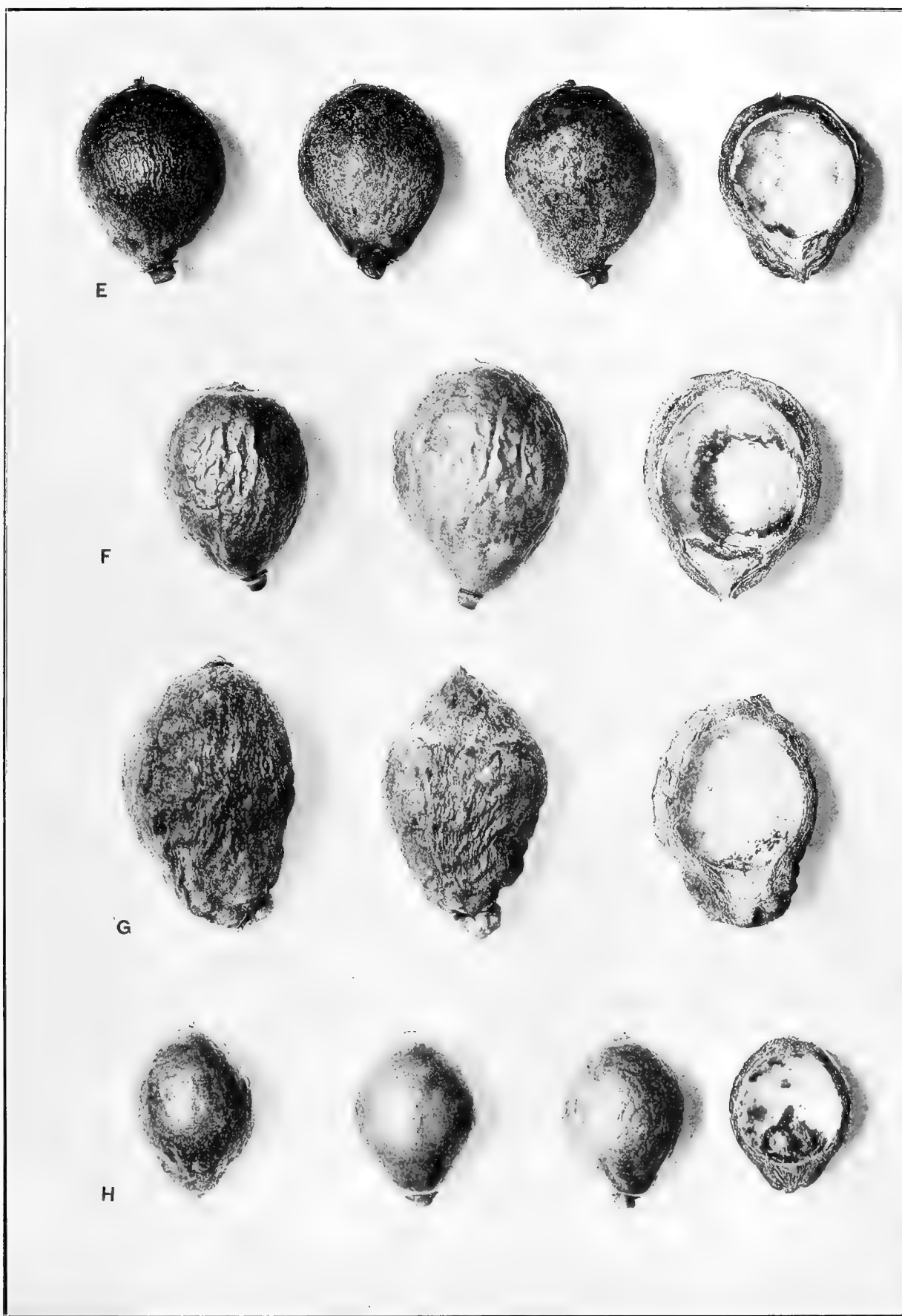
B, PRITCHARDIA ERIOPHORA BECC. FRUITING BRANCH.



PRITCHARDIA MINOR BECC. FRUITING BRANCH.



FRUITS OF PRITCHARDIA.
A, *Pritchardia Lowreyana* Rock; *B*, *Pritchardia Gaudichaudii* H. Wendl.; *C*, *Pritchardia montis-kea* Rock; *D*, *Pritchardia arecina* Becc. (Natural size.)



FRUITS OF PRITCHARDIA.

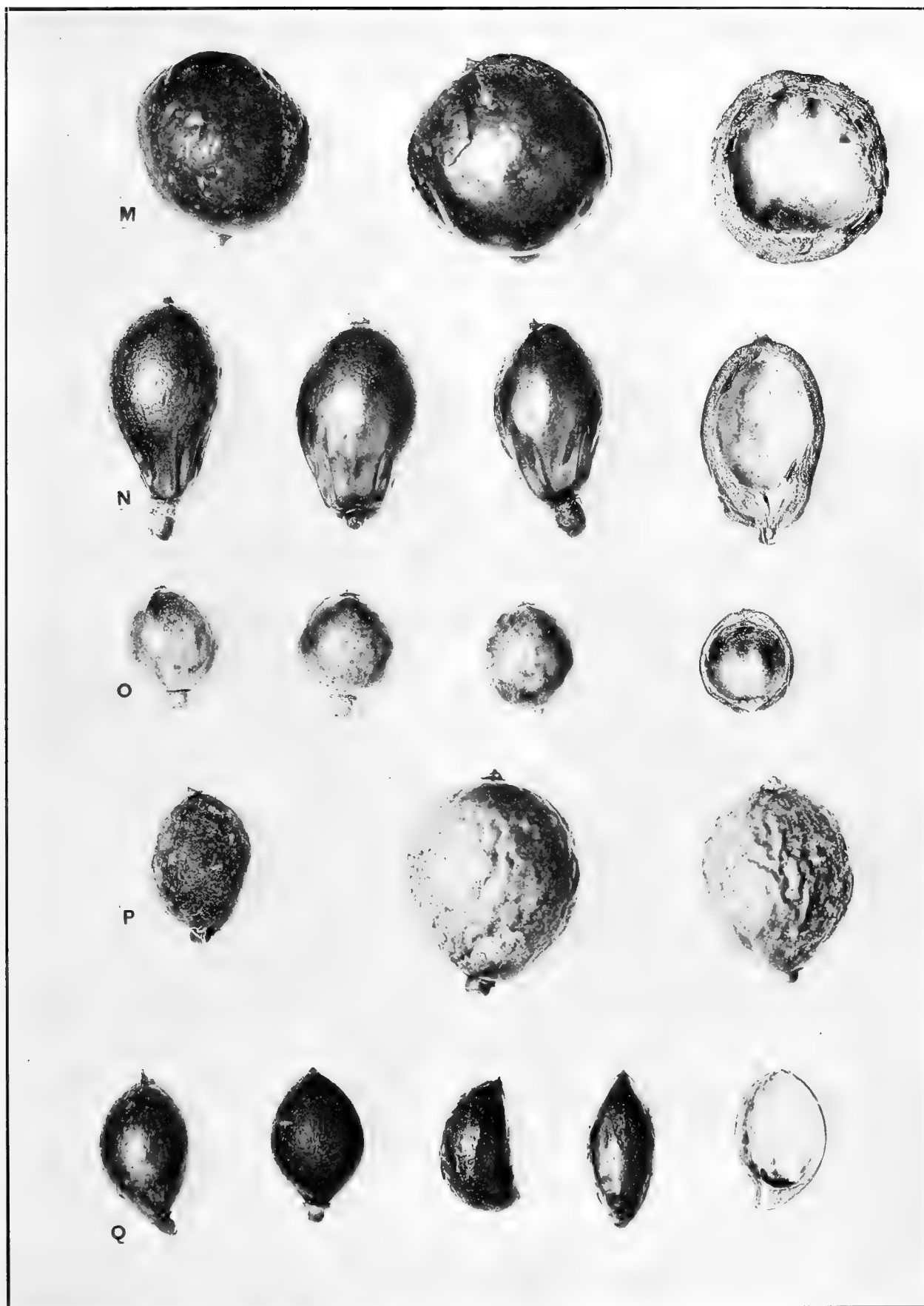
E, *Pritchardia Martii* H. Wendl. (from Moanalua Valley, Oahu); *F*, *Pritchardia macrocarpa* Linden; *G*, *Pritchardia Rockiana* Becc.; *H*, *Pritchardia kaalae* Rock. (Natural size.)





FRUITS OF PRITCHARDIA.

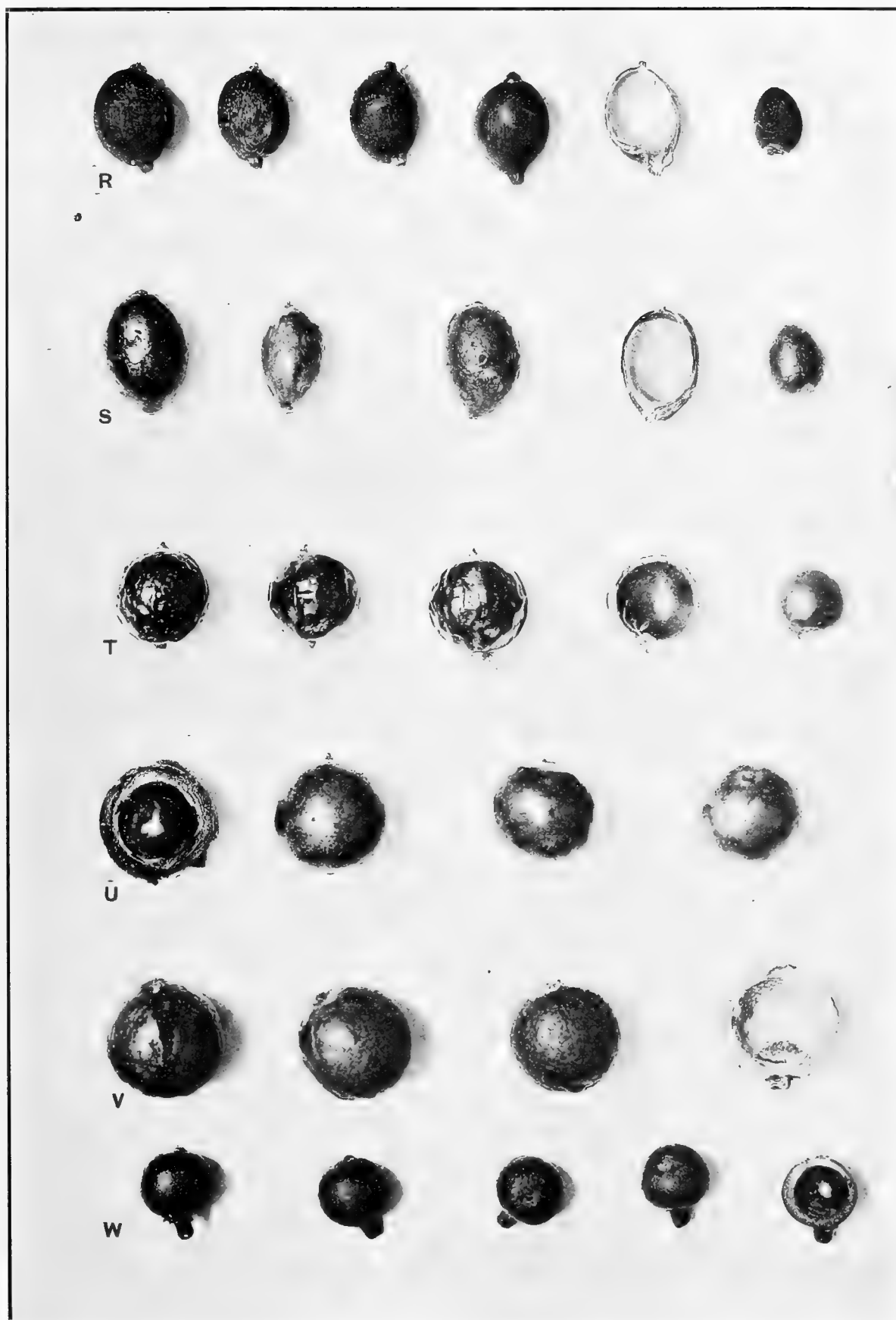
I, *Pritchardia erostachya* Becc.; *J*, *Pritchardia Lowreyana* var. *turbinata* Rock; *K*, *Pritchardia affinis* Becc.; *L*, *Pritchardia affinis* var. *rhopalocarpa* Becc. (Natural size.)



FRUITS OF PRITCHARDIA.

M, *Pritchardia Beccariana* Rock; *N*, *Pritchardia viscosa* Rock; *O*, *Pritchardia remota* Becc.;
P, *Pritchardia brevicalyx* Becc. et Rock; *Q*, *Pritchardia eriophora* Becc. (Natural size.)





FRUITS OF PRITCHARDIA.

R, *Pritchardia Hardyi* Rock; *S*, *Pritchardia minor* Becc.; *T*, *Pritchardia Hillebrandi* Becc.;
U, *Pritchardia Munroi* Rock; *V*, *Pritchardia lanaiensis* Becc. et Rock; *W*, *Pritchardia*
pacifica. (Natural size.)



A CONTRIBUTION TO SAMOAN SOMATOLOGY

By LOUIS R. SULLIVAN

BASED ON THE FIELD STUDIES OF E. W. GIFFORD AND W. C. MCKERN

GN
670
B518
V18
702
509

Memoirs of the Bernice Pauahi Bishop Museum, *Honolulu*
Volume VIII—Number 2

WITH PLATES XXV-XXX

BAYARD DOMINICK EXPEDITION

PUBLICATION NUMBER I

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A CONTRIBUTION TO SAMOAN SOMATOLOGY

By LOUIS R. SULLIVAN

611

Based on the field studies of E. W. Gifford and W. C. McKern.

INTRODUCTION

THE determination of the physical characters and of the racial affinities of the Polynesians is an essential part of the program of the Bayard Dominick Expedition. Through a coöperative arrangement between The American Museum of Natural History and the Bishop Museum this phase of the work, including detailed plans for field investigation and the analysis of results, has been placed in my hands. To insure uniformity of technique and consequent comparability of results, methods of taking measurements and of recording descriptive observations have been discussed with members of the Expedition, and so far as practicable actual field practice has been given under my direction.

The present paper is based on field studies made by E. W. Gifford and W. C. McKern while en route to the Tonga Islands. These men spent some time with me in Honolulu gaining familiarity with modern anthropometric methods, and I feel the greatest confidence in the care and accuracy with which their observations have been recorded. The photographs were taken by Mr. Gifford and Mr. McKern; the necessary mathematical computation including calculation of the indices were performed by my wife, Bessie P. Sullivan, and checked by me; and in the field Mrs. Delila S. Gifford rendered valuable assistance. The Museum acknowledges the cordial coöperation of Mr. R. W. Tate, Administrator of Western Samoa, of the officers of the Medical Department and the Department of Native Affairs, and of the Police.

Although the series is too small to permit detailed statistical analyses and inadequate as a bases for generalization, the present great dearth of somatological data from the Polynesian culture area makes this material a welcome and important contribution.

The data furnished by Gifford and McKern consists of body, head, and face measurements, accompanied by descriptive details of 100 natives of the Islands of Savaii and Upolu of the Samoan group. By nativity the persons measured represent nearly the entire coastal region of these two islands. Of the 100 measurements 7 were discarded because of admitted intermixture with European and Melanesian peoples or because of immaturity. Of the 93 remaining adults who claimed to be full Samoan, 70 are male and 23 female. It is possible or even probable that several others are not full Samoan, but this can not be demonstrated statistically. Types of full-blood and half-blood Samoans are shown in Plates XXV-XXX

CHARACTERS NOT QUANTITATIVELY MEASURABLE

SKIN COLOR

Skin color is very difficult to record accurately even with the help of color standards, all of which are admittedly inadequate. At the time this work was undertaken, von Luschan's "Hautfarben-Tafel," which is the most practical standard in use at present, was not available. Fritsch's standard, which is much less permanent and entirely impractical for field work, was therefore used, and the results were translated as nearly as possible into terms of von Luschan's scale. The observations were made in two places—an unexposed portion of the skin, preferably the inner side of the upper arm, and an exposed place, uniformly the cheek just below the zygomatic arches. For the unexposed skin the color ranges from number 10 to number 24 of von Luschan's scale, numbers 14, 15, and 16 predominate. In the women the shades run about one degree lighter and numbers 13, 14, and 15 predominate. For the exposed skin of the men numbers 15, 16, 17, or 18 predominate. Again, the color of the women runs about one shade lighter, in most being number 14, 15, or 16. In terms of black and white the color ranges from very light flesh yellow to deep brown. A slightly yellowish medium brown predominates.

HAIR

For hair form the following choice of adjectives was made: straight, low waves, deep waves, curly, frizzly, woolly. It was agreed not to judge by the general effect, but to examine individual hairs. In addition hair samples were collected and the results checked up in the laboratory. The conception of the various terms agreed upon correspond to the following letters in Martin's *Schema der Haarform*, ("Lehrbuch der Anthropologie," fig. 52, page 189): straight=a, b, c; low waves=d; deep waves=e; curly=f; frizzly no equal, but refers to the fine deep waves so common where intermixture with woolly-haired people has taken place; woolly=g, h, i; tufted or spiral=k, l.

The chief differences are due to the fact that our classification was not so minute as Martin's and that we distinguished between fine straight hair and wavy hair. The results are shown in Table I.

The choice of terms for hair color was black, dark brown, reddish brown, light brown, blond, golden, red, gray. Attention was given to the prevalence of customs of artificial bleaching. The results show that the practice of bleaching the hair with lime is still in vogue to some extent. The details are given in Table II.

TABLE I. HAIR FORM

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Straight	38	55.1	11	47.8
Low waves	19	27.5	9	39.1
Deep waves	7	10.1	2	8.8
Curly	4	5.8	0	.0
Frizzly	1	1.4	1	4.3
Woolly	0	.0	0	.0
Total.....	69		23	

TABLE II. HAIR COLOR

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Black	64	91.4	13	56.9
Dark brown....	3(2) ¹	4.3(2.8)	2(4)	8.8(17.4)
Reddish brown....	0	.0	0(3)	.0(13.0)
Light brown....	0(1)	.0(1.4)	0(1)	.0(4.3)
Blond.....	0	.0	0	.0
Golden.....	0	.0	0	.0
Red.....	0	.0	0	.0
Gray .....		.0	.0	.0
Total.....	70		23	

The amount and distribution of the beard was carefully noted. The choice of terminology was: none, scant, medium, heavy. The beard was considered as divided into three parts: upper cheek (from the hair line to an imaginary line bisecting the angle of the mandible), lower cheek (from the point where the imaginary line bisects the angle of the mandible to a point immediately below the corner of the mouth), and the chin. The observations resulted as follows:

TABLE III. BEARD: UPPER CHEEK—MALES ONLY.

	Number persons	Per cent
None	7	10.1
Scant	32	46.3
Medium	22	31.9
Heavy	8	11.5
Total	69	

TABLE IV. BEARD: LOWER CHEEK—MALES ONLY.

	Number persons	Per cent
None	10	14.5
Scant	30	43.3
Medium	16	23.2
Heavy	13	18.8
Total	69	

TABLE V. BEARD: CHIN—MALES ONLY.

	Number persons	Per cent
None	00	.0
Scant	16	23.2
Medium	19	27.5
Heavy	34	49.2
Total	69	

TABLE VI. HAIR ON CHEST—MALES ONLY.

	Number persons	Per cent
None	40	59.7
Scant	15	22.3
Medium	10	14.9
Heavy	2	3.0
Total	67	

TABLE VII. HAIR ON FOREARM—MALES ONLY

	Number persons	Per cent
None	2	3.0
Scant	13	19.1
Medium	24	35.3
Heavy	29	42.6
Total	68	

TABLE VIII. HAIR ON LEGS—MALES ONLY.

	Number persons	Per cent
None	0	.0
Scant	5	7.2
Medium	29	42.0
Heavy	35	50.7
Total	69	

¹ The figures in parentheses show the numbers and averages for lime-bleached hair.

EYE

The following descriptive terms were used for eye color: black, dark brown, light brown, blue, gray, blue-brown, gray-brown. Black was used for the very heavily pigmented brown eye which on casual examination appears black. Blue-brown and gray-brown were employed to designate those very light brown eyes which are often termed green or hazel. The basic color is either a blue or a gray with a discontinuous distribution of brown pigment either radiating from around the pupil or distributed in specks throughout the iris.

TABLE IX. EYE COLOR.

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Black	2	2.9	3	13.0
Dark brown	67	97.1	19	82.6
Light brown	0	.0	1	4.3
Blue	0	.0	0	.0
Gray	0	.0	0	.0
Blue-brown	0	.0	0	.0
Gray-brown	0	.0	0	.0
Total	69		23	

The terminology used to designate the condition of the conjunctiva was clear, speckled, yellow, dull, blood-shot. It was found, however, that with the exception of "clear" all the other terms might sometimes be applied to a single eye. For this reason the data have been tabulated under two heads only, "clear," and "unclear," unclear including speckled, yellow, and dull muddy eyes. "Blood-shot" was not represented.

TABLE X. CONDITION OF CONJUNCTIVA

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Clear	16	23.5	10	45.4
Unclear	52	76.5	12	54.6
Total	68		22	

TABLE XI. THE MONGOLOID OR EPICANTHIC EYE FOLD

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Absent	47	68.1	11	47.8
Trace	19	27.5	10	43.4
Medium	2	2.8	2	8.8
Marked	1	1.4	0	.0
Total	69		23	

NOSE

The elevation of the nasal bridge from the face was estimated in terms of low, medium or high. The European nose was the conception of high. As a rule the contour of the nostrils in man is nearly oval. The method adopted in describing the nostrils is based on an imaginary long axis through the oval and its orientation in relation to the facial plane. In most Europeans the long axes of the nostrils point directly forward in an antero-posterior direction from the facial plane

(fig. 1, *A*). In negroes the long axis runs parallel to the plane of the face in a transverse direction (fig. 1, *C*). In mongoloid peoples the axes point obliquely forward (fig. 1, *B*).

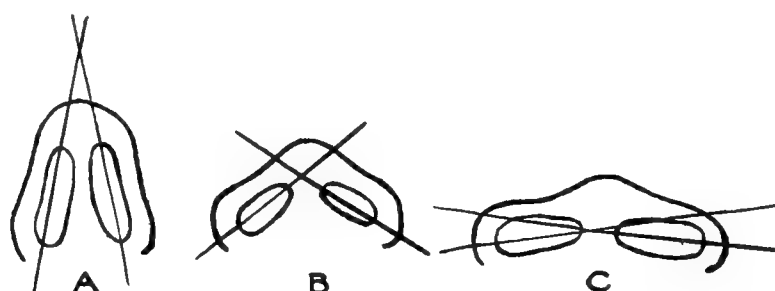


FIGURE 1. Types of nostrils: *A*, antero-posterior; *B*, oblique; *C*, transverse.

TABLE XII. NASAL BRIDGE

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Low	15	21.4	13	56.9
Medium	45	64.3	9	39.1
High	10	14.3	1	4.3
Total	70		23	

TABLE XIII. DIRECTION OF THE LONG AXIS OF THE NOSTRILS

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Antero-posterior..	2	2.9	0	.0
Oblique	39	57.3	9	39.1
Transverse	27	39.7	14	60.9
Total	69		23	

EAR

The terminology used for the ear lobe was: none, small separate, small attached, large separate, large attached. The distribution follows:

TABLE XIV. EAR LOBE

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
None	7	10.4	0	.0
Small separate	26	38.8	6	26.1
Small attached	23	34.3	13	56.5
Large separate	10	14.9	3	13.0
Large attached	1	1.4	1	4.3
Total	67		23	

The extent of the roll of the helix of the ear was noted. The helix was roughly divided into three parts designated as the first-third, the second-third, and the total helix. The first-third refers to that portion of the helix terminating in the vicinity of the supraaurale, the second-third extends from this point to a point just below the position of the tuberculare.

TABLE XV. ROLL OF THE HELIX

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Helix flat	0	.0	0	.0
Helix rolled thru first-third	13	19.4	11	47.8
Helix rolled thru second-third	30	44.7	7	30.4
Helix rolled thru entire	24	35.8	5	21.7
Total	67		23	

TABLE XVI. DARWIN'S TUBERCLE

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Absent	53	81.5	18	78.2
Present	12	18.4	5	21.7
Total	65		23	

(Only well-marked tubercles were recorded.)

TEETH

The upper incisor teeth were examined for the purpose of noting the presence or absence of that type which Hrdlicka has aptly described as "shovel-shaped." The peculiarity referred to is located on the lingual surface of the upper incisor teeth. An upgrowth from the cingulum branches near the gingival border and extends along the lateral and mesial border of the tooth, forming a rim and leaving a concavity or depression in the lingual surface. The lingual surface of such a tooth presents an appearance not unlike that of a coal shovel. Examples of this type of tooth are most often found in American Indians, Malays, Chinese, Japanese, Koreans, and other Mongoloid types.

TABLE XVII. SHOVEL-SHAPED UPPER INCISORS

MESIAL INCISORS					LATERAL INCISORS				
	Male		Female			Male		Female	
	Number persons	Per cent	Number persons	Per cent		Number persons	Per cent	Number persons	Per cent
Absent	45	68.2	16	76.2	Absent	33	51.5	12	57.1
Trace	17	25.7	3	14.3	Trace	22	34.3	5	23.8
Marked	4	6.0	2	9.5	Marked	9	14.1	4	19.0
Total	66		21		Total	64		21	

TABLE XVIII. SLOPE OF THE FOREHEAD

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Vertical	29	40.0	18	85.7
Moderate slope....	41	58.5	3	14.3
Low	1	1.5	0	0
Total	71		21	

TABLE XIX. DEVELOPMENT OF THE GLABELLA

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Smooth	20	29.4	23	100.0
Medium	38	55.8	0	.0
Prominent	10	14.7	0	.0
Total	68		23	

TABLE XX. THICKNESS OF THE LIPS

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
Thin	0	.0	1	4.3
Medium	65	92.8	21	91.4
Thick	5	7.1	1	4.3
Total	70		23	

TABLE XXI. PROGNATHISM—UPPER FACIAL PROFILE

	Male		Female	
	Number persons	Per cent	Number persons	Per cent
None	38	56.7	16	69.6
Slight	16	23.8	3	13.0
Medium	12	17.8	4	17.4
Marked	1	1.4	0	.0
Total	67		23	

ABSOLUTE MEASUREMENTS

TABLE XXII
STATURE (WITHOUT SHOES)

Centimeters	Number male	Number female
155	---	2
6	---	2
7	---	1
8	---	2
9	---	1
---	---	---
160	---	4
1	---	1
2	4	5
3	0	1
4	1	0
---	---	---
165	3	0
6	6	2
7	5	0
8	1	0
9	6	0
---	---	---
170	1	1
1	4	0
2	6	0
3	6	0
4	4	0
---	---	---
175	4	0
6	6	0
7	2	1
8	3	---
9	2	---
---	---	---
180	2	---
1	0	---
2	2	---
3	0	---
4	1	---
---	---	---
Male		Female
Total	69	23
Average	171.7	161.2
S.D.	5.25	4.92
E.	0.63	1.02
V. in per cent	3.05	3.05

TABLE XXIII
MAXIMUM HEAD LENGTH
(GLABELLA-OPISTHO-CRANIUM)

Millimeters	Number male	Number female
173	---	1
4	1	1
---	---	---
175	0	0
6	0	0
7	1	0
8	0	3
9	0	1
---	---	---
180	0	0
1	1	2
2	1	4
3	2	2
4	2	2
---	---	---
185	5	0
6	4	2
7	3	0
8	3	2
9	5	0
---	---	---
190	5	1
1	4	0
2	3	1
3	7	0
4	4	0
---	---	---
195	4	1
6	5	---
7	1	---
8	3	---
9	1	---
---	---	---
200	0	---
1	1	---
2	0	---
3	1	---
4	0	---
---	---	---
205	1	---
Male		Female
Total	68	23
Average	190.6	183.0
S.D.	5.69	5.22
E. ....	.69	1.08
V. in per cent	2.98	2.85

TABLE XXIV
MAXIMUM HEAD WIDTH

Millimeters	Number male	Number female
140	---	1
1	---	1
2	---	0
3	1	2
4	0	1
---	---	---
145	0	0
6	2	4
7	1	5
8	3	0
9	2	2
---	---	---
150	4	2
1	2	1
2	2	0
3	7	1
4	5	1
---	---	---
155	8	1
6	5	0
7	9	1
8	5	---
9	3	---
---	---	---
160	3	---
1	3	---
2	1	---
3	0	---
4	0	---
---	---	---
165	1	---
6	1	---
7	---	---
8	---	---
9	---	---
---	---	---
Male		Female
Total	68	23
Average	154.8	148.1
S.D.	4.46	3.87
E. ....	.54	.80
V. in per cent	2.88	2.61

TABLE XXV MINIMUM FRONTAL DIAMETER		
Millimeters	Number male	Number female
90	1	—
1	1	—
2	2	—
3	2	—
4	1	—
<hr/>		
95	2	2
6	1	1
7	1	2
8	1	1
9	3	1
<hr/>		
100	5	3
1	5	1
2	5	2
3	2	0
4	4	3
<hr/>		
105	3	3
6	6	1
7	7	2
8	4	1
9	1	0
<hr/>		
110	3	—
11	4	—
12	0	—
13	1	—
14	2	—
<hr/>		
115	0	—
16	0	—
17	0	—
18	1	—
19	0	—
<hr/>		
	Male	Female
Total	68	23
Average	103.4	101.5
S.D.	5.98	3.96
E. ....	.72	.82
V. in per cent	5.78	3.90

TABLE XXVI MAXIMUM FACE WIDTH (BIZYGOMATIC DIAMETER)		
Millimeters	Number male	Number female
130	—	0
1	—	1
2	—	3
3	—	3
4	—	1
<hr/>		
135	0	1
6	1	4
7	1	1
8	5	3
9	2	1
<hr/>		
140	3	2
1	4	0
2	2	0
3	5	2
4	6	0
<hr/>		
145	7	1
6	5	—
7	4	—
8	6	—
9	0	—
<hr/>		
150	3	—
1	5	—
2	1	—
3	3	—
4	1	—
<hr/>		
155	0	—
6	3	—
7	0	—
8	1	—
9	1	—
<hr/>		
	Male	Female
Total	69	23
Average	145.9	136.5
S.D.	5.23	3.79
E. ....	.63	.79
V. in per cent	3.59	2.77

TABLE XXVII BIGONIAL DIAMETER		
Millimeters	Number male	Number female
89	—	1
90	—	0
1	—	0
2	1	1
3	0	0
4	1	1
<hr/>		
95	0	1
6	3	1
7	1	3
8	5	0
9	4	2
<hr/>		
100	5	5
1	4	2
2	2	2
3	4	1
4	2	1
<hr/>		
105	4	2
6	8	—
7	4	—
8	4	—
9	3	—
<hr/>		
110	4	—
11	0	—
12	3	—
13	0	—
14	1	—
<hr/>		
115	1	—
16	1	—
17	1	—
18	0	—
19	0	—
<hr/>		
120	1	—
1	0	—
2	0	—
3	1	—
4	0	—
<hr/>		
	Male	Female
Total	67	23
Average	104.6	99.0
S.D.	5.13	3.93
E. ....	.62	.82
V. in per cent	4.90	3.96

TABLE XXVIII. ANATOMICAL FACE HEIGHT
(NASION TO GNATHION)

Millimeters	Number male	Number female
110	....	1
11	....	1
12	....	0
13	....	0
14	....	1
<hr/>		
115	1	1
16	0	3
17	0	0
18	1	2
19	0	1
<hr/>		
120	1	2
1	1	1
2	2	2
3	3	0
4	4	1
<hr/>		
125	3	1
6	5	1
7	2	1
8	1	1
9	4	1
<hr/>		
130	2	0
1	5	0
2	3	0
3	5	1
4	3	0
<hr/>		
135	5	1
6	6	....
7	2	....
8	1	....
9	0	....
<hr/>		
140	2	....
1	2	....
2	2	....
3	2	....
4	0	....
<hr/>		
145	1	....

	Male	Female
Total	69	23
Average	131.1	121.1
S.D.	6.56	6.41
E. ....	.79	1.33
V. in per cent	5.00	5.30

TABLE XXIX. NOSE HEIGHT
(NASION TO SUBNASALE)

Millimeters	Number male	Number female
45	....	1
6	....	0
7	....	0
8	....	1
9	....	1
<hr/>		
50	0	2
1	1	1
2	2	1
3	1	4
4	1	2
<hr/>		
55	3	2
6	2	2
7	4	0
8	10	0
9	7	2
<hr/>		
60	11	1
1	10	1
2	5	2
3	2	....
4	2	....
<hr/>		
65	3	....
6	2	....
7	0	....
8	2	....
9	1	....
<hr/>		

	Male	Female
Total	69	23
Average	59.8	54.3
S.D.	3.64	4.53
E. ....	.43	.94
V. in per cent	6.09	8.34

INDICES AND PROPORTIONS

HEAD INDICES

TABLE XXXIII

CEPHALIC OR LENGTH-BREADTH INDEX

Index	Number male	Number female
74	2	---
75	2	0
6	1	3
7	6	1
8	7	4
9	0	0
80	11	0
1	7	3
2	9	4
3	5	4
4	4	2
85	5	1
6	3	1
7	4	---
8	0	---
9	2	---
		Male
Total	68	23
Average	81.3	80.8
S.D.	3.53	2.98
E. ....	.42	.62
V. in per cent	4.34	3.68

TABLE XXXIV

TRANSVERSE FRONTO-PARIETAL INDEX

(Minimum frontal $\times 100$)
 (Maximum head width)

Index	Number male	Number female
55	---	---
6	---	---
7	1	---
8	1	---
9	1	---
60	3	---
1	0	---
2	1	---
3	5	1
4	6	0
65	5	2
6	6	4
7	7	2
8	9	3
9	11	2
70	3	1
1	2	2
2	2	2
3	3	2
4	2	2
		Male
Total	68	23
Average	66.8	68.8
S.D.	3.30	3.12
E. ....	.40	.65
V. in per cent	4.94	4.54

FACE INDICES

TABLE XXXV CEPHALO-FACIAL INDEX		
($\frac{\text{maximum face width} \times 100}{\text{maximum head width}}$)		
Index	Number male	Number female
85	0	....
6	1	....
7	0	....
8	2	1
9	1	2
<hr/>		
90	1	4
1	4	2
2	8	5
3	10	2
4	12	2
<hr/>		
95	8	1
6	7	2
7	7	1
8	3	1
9	2	0
<hr/>		
100	1	....
1	0	....
2	1	....
3	....	....
4	....	....
<hr/>		
	Male	Female
Total	68	23
Average	94.2	92.4
S.D.	2.84	2.63
E. ....	.34	.54
V. in per cent	3.01	2.84

TABLE XXXVI JUGO-MANDIBULAR INDEX		
($\frac{\text{bigonial diameter} \times 100}{\text{maximum face width}}$)		
Index	Number male	Number female
60	....	....
1	....	....
2	1	....
3	0	....
4	1	....
<hr/>		
65	2	....
6	1	....
7	3	2
8	7	4
9	4	1
<hr/>		
70	3	0
1	8	2
2	11	1
3	7	2
4	4	0
<hr/>		
75	5	5
6	3	5
7	2	0
8	2	1
9	2	0
<hr/>		
80	0	....
1	0	....
2	1	....
3	....	....
4	....	....
<hr/>		
	Male	Female
Total	67	23
Average	71.7	72.5
S.D.	3.84	3.50
E. ....	.46	.73
V. in per cent	5.42	4.83

TABLE XXXVII JUGO-FRONTAL INDEX		
($\frac{\text{minimum frontal diameter} \times 100}{\text{maximum face width}}$)		
Index	Number male	Number female
60	....	....
1	....	....
2	1	....
3	1	....
4	2	....
<hr/>		
65	1	....
6	3	....
7	2	....
8	6	....
9	6	1
<hr/>		
70	7	3
1	9	1
2	3	0
3	10	3
4	8	5
<hr/>		
75	5	3
6	1	2
7	0	0
8	2	2
9	1	0
<hr/>		
80	....	2
1	....	0
2	....	1
3	....	....
4	....	....
<hr/>		
	Male	Female
Total	68	23
Average	70.9	74.5
S.D.	3.55	3.34
E. ....	.43	.69
V. in per cent	5.01	4.49

TABLE XXXVIII
ANATOMICAL FACIAL INDEX
(GARSON)
$$\left(\frac{\text{anatomical face height} \times 100}{\text{maximum face width}} \right)$$

Index	Number male	Number female
79	1	—
80	1	1
1	0	1
2	1	0
3	0	3
4	6	2
85	3	1
6	4	5
7	9	2
8	5	0
9	3	0
90	9	1
1	3	1
2	3	0
3	3	0
4	5	3
95	4	1
6	3	1
7	0	0
8	2	1
9	1	0
100	0	—
1	0	—
2	1	—
3	0	—
4	1	—
Male		Female
Total	68	23
Average	89.9	89.8
S.D.	4.87	5.03
E. ....	.59	1.05
V. in per cent	5.42	5.60

TABLE XXXIX
NASAL INDEX

Index	Number male	Number female
60	0	—
1	1	—
2	0	—
3	1	—
4	0	—
65	2	0
6	3	2
7	3	0
8	3	3
9	3	0
70	5	1
1	5	0
2	9	1
3	4	2
4	4	1
75	4	0
6	1	3
7	3	1
8	3	2
9	3	1
80	4	2
1	2	0
2	1	1
3	1	1
4	1	0
85	1	0
6	0	0
7	0	0
8	0	0
9	1	0
90	1	1
1	—	0
2	—	0
3	—	0
4	—	0
95	—	0
6	—	0
7	—	0
8	—	0
9	—	0
100	—	0
1	—	0
2	—	1
3	—	—
4	—	—
Male		Female
Total	69	23
Average	73.6	76.3
S.D.	5.86	7.99
E. ....	.70	1.66
V. in per cent	7.96	10.47

TABLE XL
PHYSIOGNOMIC EAR INDEX

Index	Number male	Number female
45	0	0
6	2	0
7	0	1
8	5	0
9	9	0
50	2	1
1	6	0
2	6	6
3	5	2
4	6	4
55	6	—
6	4	1
7	6	2
8	7	2
9	1	1
60	1	6
1	1	6
2	1	1
3	—	0
4	—	0
65	—	0
6	—	0
7	—	0
8	—	0
9	—	0
70	—	1
1	—	—
2	—	—
3	—	—
4	—	—
Male		Female
Total	68	23
Average	53.3	54.9
S.D.	3.79	4.53
E. ....	.46	.94
V. in per cent	7.11	8.25

SUMMARY OF SOMATOLOGICAL CHARACTERS OF SAMOANS

TABLE XLI. CHARACTERS NOT QUANTITATIVELY MEASURABLE

CHARACTER	MALE	FEMALE
Skin color (Unexposed part)	Medium yellowish-brown von Luschan's Nos. 14, 15, 16.	Medium yellowish brown von Luschan's Nos. 13, 14, 15.
Hair form	Straight 55.1% Low waves 27.5%	Straight 47.8% Low waves 39.1%
Hair color	Black 91.4	Black 56.9, dark brown 8.8 34.7% bleached
Amount of beard:		
Upper cheek	Scant 46.3, medium 31.9	
Lower cheek	Scant 43.3, medium 23.2	
Chin	Medium 27.5, heavy 49.2	
Amount of hair:		
Chest	None 59.7, scant 22.3	
Forearm	Medium 35.3, heavy 42.6	
Leg	Medium 42.0, heavy 50.7	
Eye color	Dark brown 97.1	Black 13.0, dark brown 82.6
Conjunctiva	Speckled, yellowish 76.5	Speckled, yellowish 54.6
Epicanthic eye fold	Absent 68.1, trace 27.5	Absent 47.8, trace 43.4
Nasal bridge	Medium height 64.3	Low 56.9, medium 39.1
Long axes of nostrils	Oblique 57.3, transverse 39.7	Oblique 39.1, transverse 60.9
Slope of forehead	Vertical 40.0 Moderate slope 58.5	Vertical 85.7
Development of glabella	Medium 55.8	Smooth 100.0
Lips: thickness	Medium 92.8	Medium 91.4
Prognathism	None 56.7, slight 23.8	None 69.6, slight 13.0
Ear-lobe	Small: separate 38.8, Attached 34.3	Small: separate 26.1, Attached 56.5
Helix rolled	Two-thirds 44.7 Total 35.8	First-third 47.8 Two-thirds 30.4
Shovel-shaped incisor		
Tooth: Upper mesials	Absent 68.2, trace 25.7	Absent 76.2, trace 14.3
Upper laterals	Absent 51.5, trace 34.3	Absent 57.1, trace 23.8

TABLE XLII. ANTHROPOMETRIC CHARACTERS

CHARACTER	MALE 67 TO 70 PERSONS				FEMALE 20 TO 23 PERSONS			
	Average	E.	S.D.	V. in %	Average	E.	S.D.	V. in %
Stature (cm.)	171.7	.63	5.25	3.05	161.2	1.02	4.92	3.05
Head length (mm.)	190.6	.69	5.69	2.98	183.0	1.08	5.22	2.85
Head width	154.8	.54	4.46	2.88	148.1	.80	3.87	2.61
Minimum frontal diameter.....	103.4	.72	5.98	5.78	101.5	.82	3.96	3.90
Maximum face width	145.9	.63	5.23	3.59	136.5	.79	3.79	2.77
Bigonial diameter	104.6	.62	5.13	4.90	99.0	.82	3.93	3.96
Anatomical face height	131.1	.79	6.56	5.00	121.1	1.33	6.41	5.30
Nose height	59.8	.43	3.64	6.09	54.3	.94	4.53	8.34
Nose width	43.8	.31	2.59	5.91	41.2	.90	2.56	6.21
Ear height	66.1	.50	4.23	6.39	61.2	.69	3.33	5.44
Ear width	35.2	.33	2.76	7.84	33.6	.48	2.30	6.84
Cephalic index	81.3	.42	3.53	4.34	80.8	.62	2.98	3.68
Fronto-parietal index	66.8	.40	3.30	4.94	68.8	.65	3.12	4.54
Cephalo-facial index	94.2	.34	2.84	3.01	92.4	.54	2.63	2.84
Jugo-mandibular index	71.7	.46	3.84	5.42	72.5	.73	3.50	4.83
Jugo-frontal index	70.9	.43	3.55	5.01	74.5	.69	3.34	4.49
Anatomical face index	89.9	.59	4.87	5.42	89.8	1.05	5.03	5.60
Nasal index	73.6	.70	5.86	7.96	76.3	1.66	7.99	10.47
Physiognomic ear index	53.3	.46	3.79	7.11	54.9	.94	4.53	8.25

DISCUSSION

The results speak for themselves and need little discussion. Attention should be called to the fact that the average anatomical face height and the average nasal height as given in these tables stand very high in the total range for these two measurements. In fact they are among the very highest values so far recorded. As we have no comparative data on this matter and as these two dimensions are difficult to take, the results should be regarded as merely tentative. While it is obvious that the Polynesians have massive faces, it is not so obvious that they exceed all other peoples in these measurements. Although I have every confidence in the accuracy of these measurements as a whole, I am convinced from my own experience that when dealing with anatomical face height and nasal height a generous allowance must be made for individual differences in technique. The nasion is particularly hard to locate if the nasal bridge is low. As the amount of fleshy tissue on the chin varies considerably in different persons, the same degree of pressure may yield quite different results. Furthermore when taking face height it is absolutely necessary to be sure that the teeth are in proper occlusion, for even when the mouth is closed and the lips together, the teeth are not necessarily in occlusion. The non-occlusion of the teeth adds from 4 to 8 millimeters to the anatomical face height. While the probabilities are that these two measurements were properly taken, attention is called to these chances for mismeasurement.

As previously mentioned comparative data from Samoa is practically non-existent. Deniker, on the basis of 25 male Samoans, gives the average stature as 172.6 centimeters or slightly greater than our average of 171.7. His cephalic index is also somewhat higher—82.7 as compared with our 81.2. Our average is much lower than others previously recorded for this area. Deniker gives the

Tongan average as 82.6, Tahitian average 85.5, Marquesan average 85.5. Our average for the nasal index is very much lower than that of Collignon for Polynesians in general (73.6 and 89.8), but the discrepancy is probably due to a different technique.

Our series is noteworthy for its homogeneity. Taken character for character the variability is very small. As compared with a series of pure Sioux Indians and another series of Sioux-White half-bloods, the coefficient of variation for nearly every character is appreciably smaller than that of either of these groups.

TABLE XLIII. COEFFICIENT OF VARIATION—MALES ONLY

	Samoaan Pure	Sioux Pure	Sioux Half-bloods
Stature	3.05	3.27	3.92
Head length	2.98	3.16	2.72
Head width	2.88	3.47	3.20
Face width	3.59	3.65	3.83
Face height	5.00	5.12	5.23
Nasal height	6.09	6.75	6.48
Nasal width	5.91	8.07	8.08
Cephalic index	4.34	4.03	3.33
Cephalo-facial index	3.01	3.35	3.40
Facial index	5.42	5.78	6.22
Nasal index	7.96	10.25	10.23

Considering the group as a unit there seems to be very little Melanesian blood in evidence. On the basis of cultural or linguistic evidence it is common to assume a large amount of Melanesian blood in all Polynesian groups. If such blood exists it should be easily demonstrable. Melanesian intermixture should result in lower stature, longer heads, broader noses, shorter ears, more curly, frizzly, and woolly hair, a smaller transverse fronto-parietal index, a lower, narrower face, greater prognathism and a heavier development of the glabella and supra-orbital region. In none of these characters does this Samoan series approach very near to the prevailing Melanesian type or types.

As to the general affinities of the Samoans, it seems wiser to wait for more comparative data before taking any definite stand as to their relationships to other Polynesians or to mankind as a whole. In view of the fact that it is becoming more and more common to describe the Polynesians as of European racial affinities, it seems desirable to keep this point in mind in summarizing the facts brought out by the material from Samoa at hand. Frequently a single character is chosen as a criterion, but there is nothing in our available somatological data to warrant such procedure. If any one character is taken as a criterion and the classification carried out to the logical end on that basis, the results are ludicrous. More often than not it is naively assumed that nature has kindly provided us with absolute criteria of race. Some rely on hair form, some on nose form, while others prefer head form or skin color. Granting that all of these characters are valuable in their proper sphere, it is useless and futile to argue as to which is the most reliable test. While hair form might work admirably as a basis of classification for the greater part of mankind, it would just as probably lead astray if used inflexibly.

For the present it seems wiser to take into consideration the totality of characters available. To do otherwise is to assume the solution of our problem in advance. Our problem is not "On the assumption that hair form is an absolute test of race, to what race does the Samoan belong?" but rather, "In the light of all the available facts where shall we place the Samoan in the scale of mankind?"

Where we place him will also vary with our conception of the relationships of the various groups of mankind to one another. The prevailing classifications of mankind are the results of two schools of workers. One school is engaged in separating mankind into as many groups as possible, and the other in attempting to point out relationships and to include all mankind in the fewest groups possible. Since the same material is necessary to accomplish both of these ends, the work is equally valuable. In the end we shall doubtless concur in a happy medium.

For myself, I find no serious difficulty in assigning the greater proportion of mankind to one of four great races: the European or white, the Mongoloid or yellow-brown, the Negro, and the Australian.

With this conception of races and the material at hand as a basis I have attempted to analyze the somatological characters of the Samoans and to designate the race to which each character pointed. This designation of race does not mean that I believe or infer that the particular character referred to has had such an origin, but that, considering the range of each character for mankind as a whole, the detail in question most nearly approaches the average of the race designated. Naturally, many characters which vary indiscriminately from race to race and even within a given race have been omitted. In this list are included stature, cephalic index, and facial index, as well as several other characters on which we have insufficient data or knowledge for such determinations. The list follows:

TABLE XLIV. ANALYSIS OF SAMOAN CHARACTERISTICS

Racial Character	Affinities
Skin color	Mongoloid
Hair texture	European
Hair form	European
Hair color	Mongoloid-European
Eye color	Mongoloid
Conjunctiva	Mongoloid-Negroid
Amount of beard	Mongoloid
Hair on chest	Mongoloid
Hair on arms	European-Mongoloid
Hair on legs	European-Mongoloid
Absence of eye fold	European
Nasal bridge	Mongoloid-European
Nostrils	Mongoloid-Negroid
Lips	Mongoloid
Prognathism	European
Incisor teeth	European
Face width	Mongoloid
Bigonial diameter	Mongoloid
Jugo-frontal index	Mongoloid-European
Cephalo-facial index	Mongoloid
Nasal index	Mongoloid
Ear height	Mongoloid
Chin	Mongoloid
Total Mongoloid	11
European	5
Mongoloid-European	5
Mongoloid-Negroid	2

On the basis of this list I am inclined to regard the Samoans as most closely allied to the Mongoloid race of mankind, and to assume that the differences are probably due either to a slightly different evolution since the time of their separation and isolation from the parental stock, or to the retention in the Samoans of a primitive character which through different evolutionary processes has been lost in most of the Mongoloid types. I think it unlikely that the differences are due to racial intermixture. Take the single character of hair form for an example. When we think of Mongoloid hair, we invariably think of stiff, coarse, black hair, though as a matter of fact such hair is one extreme of the variation of hair form in man and most probably an end form in evolution. It seems more probable that the primitive hair form in man was at least slightly wavy, and that woolly and spiral hair present one end of an extreme specialization, and the coarse, stiff, straight hair the other end.

Another outstanding difference between the Samoans and Mongols in general is the low frequency of the shovel-shaped upper incisor tooth. On the other hand it seems reasonable to assume that the Polynesians at one time had this primitive Mongoloid characteristic and have lost it in part in their recent evolutionary history. The incisor teeth in this group have paralleled the tendency of the incisor teeth in European man and have become smaller in size. The absence of this incisor fold is due to a tendency in mankind to a reduction in dentition and is not the result of racial intermixture. My observation leads me to believe that the presence of this character is not one to disappear in mixed peoples. Certainly a fairly high percentage of the part-Hawaiian population have the incisor fold. In more than one Mongol group this characteristic is tending to disappear, if that can be inferred from lower frequency.

In conclusion we may say at least that it is far more difficult to reconcile European racial origin for the Samoans and Polynesians in general, than it is to assume Mongoloid affinities and origins.

Although the results of the present discussion must be considered as somewhat tentative because of the small amount of available data, it is nevertheless time that anthropologists should discontinue the practise of speaking vaguely of European origins for the Polynesians and begin to cite the specific characteristics that lead to their conclusions. Likewise there seems to be little benefit in referring to Melanesian admixture, unless we point out specifically and statistically those characters which point in this direction. It is not fair to assume that the facts upon which one's opinions are based are generally known. Scientists who have the privilege of working in inaccessible localities owe it to their colleagues to be as specific as possible in giving the reasons for their generalizations.



A. THREE SAMOAN MEN OF RANK: (1) AND (2) A CHIEF;
(3) AND (4) A JUDGE; (5) AND (6) AN ORATOR.



B. SAMOAN WOMEN.

Photographs by Gifford and McKern.



A. MALE FULL-BLOOD SAMOANS.



B. MALE FULL-BLOOD SAMOANS.

Photographs by Gifford and McKern.

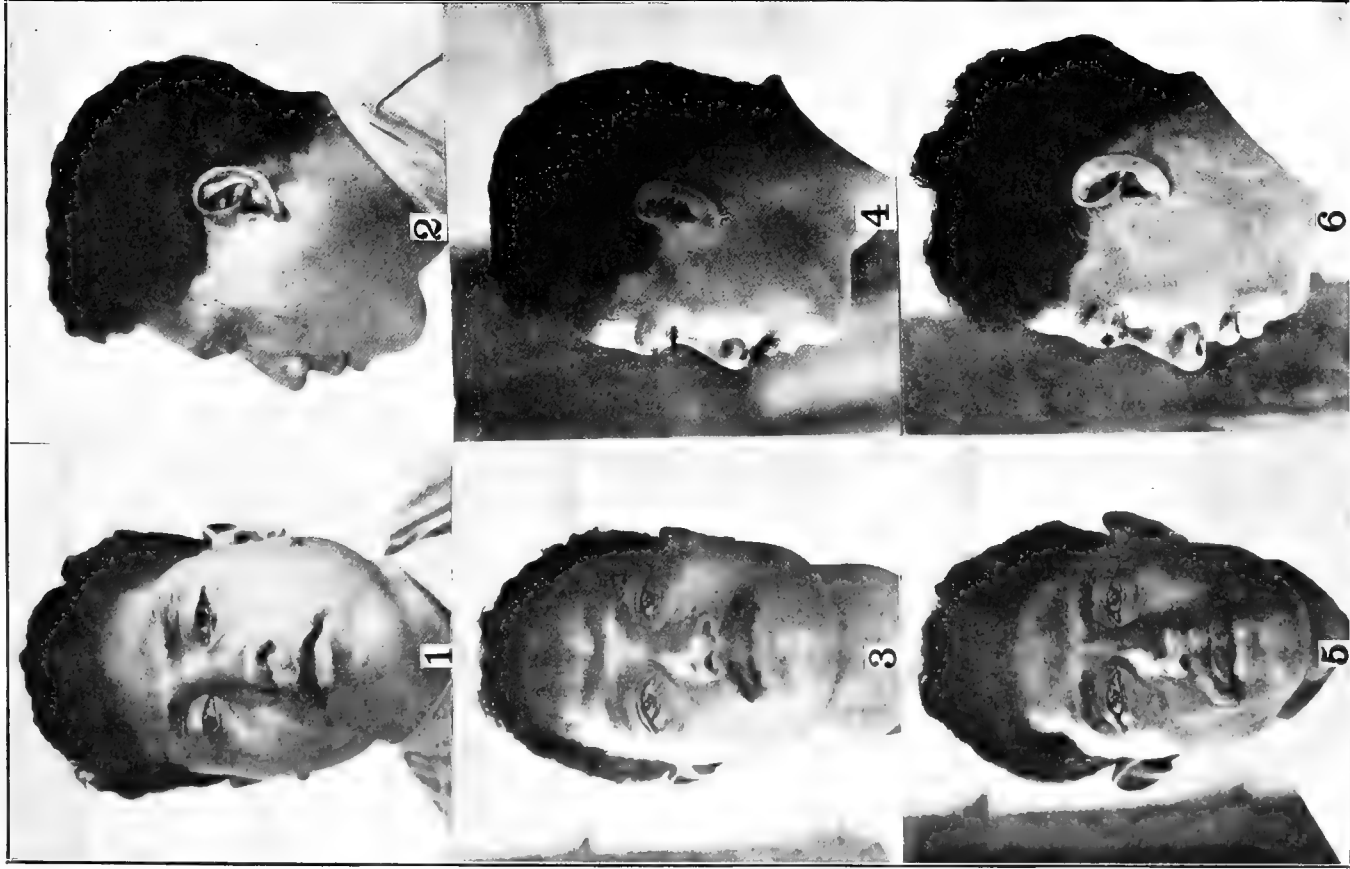


A. MALE FULL-BLOOD SAMOANS.

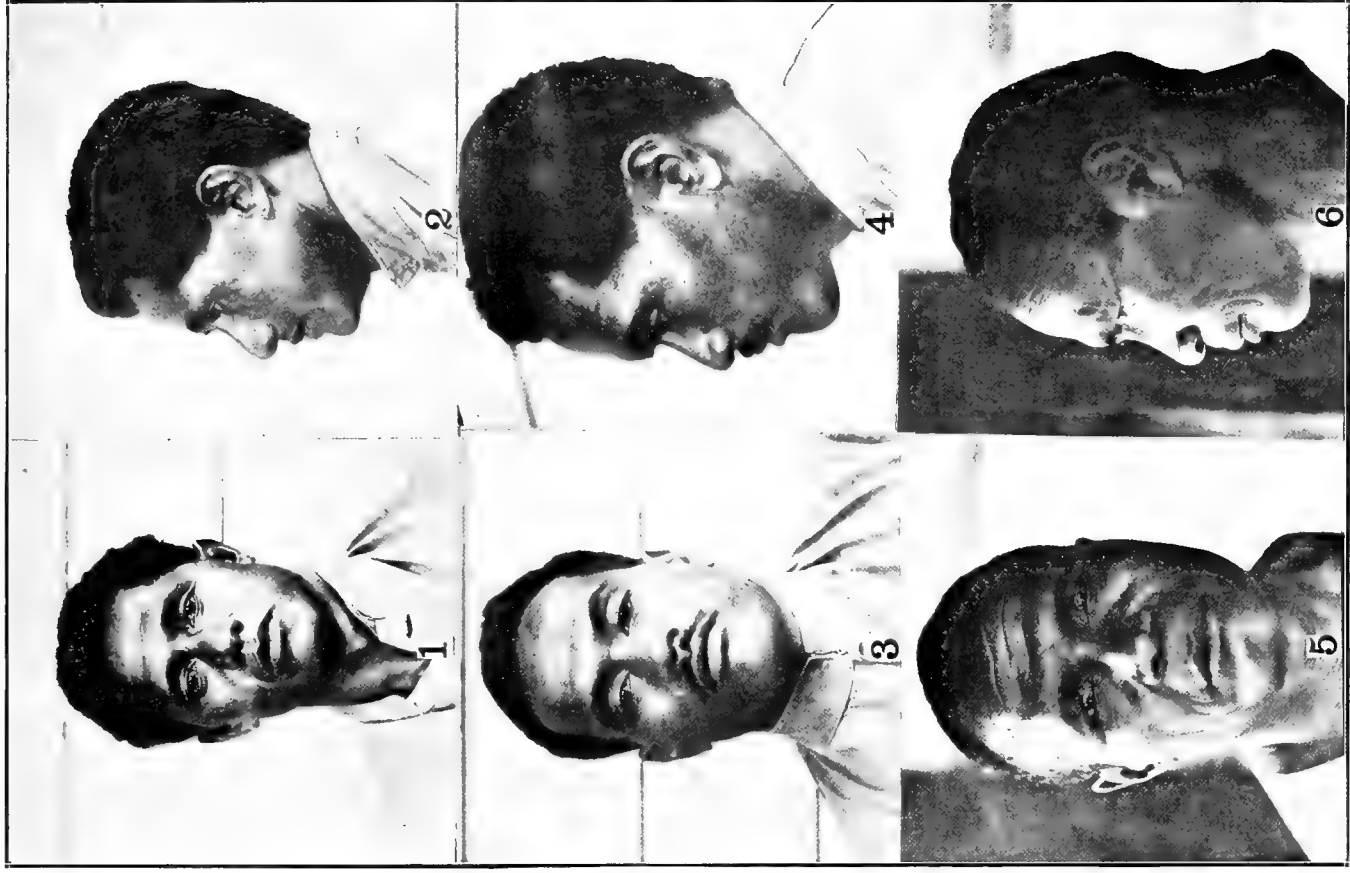


B. MALE FULL-BLOOD SAMOANS.

Photographs by Gifford and McKern.



A. MALE FULL-BLOOD SAMOANS.



B. MALE FULL-BLOOD SAMOANS.

Photographs by Gifford and McKern.



4. MALE FULL-BLOOD SAMOANS.



5. MALE FULL-BLOOD SAMOANS.

Photographs by Gifford and McKern.



A. MALE FULL-BLOOD SAMOANS.



B. MIXED BLOOD SAMOANS: (1) AND (2) SAMOAN $\frac{1}{4}$, WHITE $\frac{3}{4}$; (3) AND (4) SAMOAN $\frac{3}{4}$, WHITE $\frac{1}{4}$; (5) AND (6) PART-SAMOAN.

Photographs by Gifford and McKern.

THE GRASSES OF HAWAII

BY

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Memoirs of the Bernice Pauahi Bishop Museum
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WITH PLATES XXXI-XXXV



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THE GRASSES OF HAWAII

BY A. S. HITCHCOCK.

INTRODUCTION.

In 1906 I made a trip to the Hawaiian islands for the purpose of studying the grasses. All the main islands of the group were visited except Niihau and barren, windswept Kahoolawe, now uninhabited. This paper is an account of the grass flora, based upon the collections made at that time and on a study of all other accessible collections from the Hawaiian islands, including those made by Professor J. F. Rock of the College of Hawaii, Mr. C. N. Forbes of the Bishop Museum, Abbé Faurie, A. A. Heller, Mann and Brigham, and the Wilkes Exploring Expedition. Specimens given by Brother Matthias Newell of Hilo and by Mr. G. C. Munro of Lanai were examined; the original set of Mann and Brigham, at the herbarium of the Botanical Department of Cornell University, was consulted and also the set of Wilkes Expedition grasses at the Gray Herbarium. All specimens cited are in the United States National Herbarium, except when otherwise stated.

The text figures in this paper, except sixteen from early bulletins of the United States Department of Agriculture, are from original drawings made by Mrs. Mary Wright Gill. As indicated in the legends several of the figures have already appeared in various Government publications. Acknowledgment is made to the Bureau of Plant Industry and to the Smithsonian Institution for the use of cuts and drawings.

Maps have not been included in the illustrations. For the position of geographic features mentioned in this report the following maps may be consulted: for Oahu and for Kauai, the topographic maps issued by the United States Geological Survey; for Hawaii, Molokai, and Maui, maps issued by the Territorial Survey. The position of the islands and their chief topographic features are well shown on Chart No. 4102 of the United States Coast and Geodetic Survey.

GENERAL DISCUSSION.

ECOLOGICAL AREAS.

The indigenous flora of the Hawaiian islands, though comparatively meager on account of the geographic position of the group in a vast expanse of surrounding ocean, is of great interest because of the isolation. The influence of geographic features and climate on the vegetation of the islands has been considered in the reports¹ that have been already published of the 1916 trip, and the general floral

¹ Hitchcock, A. S., (1) Botanical explorations in the Hawaiian Islands: Smithsonian Misc. Coll. Vol. 66, no. 17, pp. 59-73, figs. 61-77, 1917; (2) A botanical trip to the Hawaiian Islands: Sci. Monthly, Vol. 5, Oct. and Nov., pp. 323-349, 419-432, figs. 1-43, may 1, 1917; (3) Floral aspects of the Hawaiian Islands: Smithsonian Rept. for 1917, pp. 449-462, pls. 1-25, 1919.

regions are discussed in detail by Hillebrand² and Rock,³ and also by Heller⁴ for the islands of Oahu and Kauai. The distribution of the grasses as limited to ecological areas is not so distinct as in many other families of plants, but the characteristic habitats of the more common species of Hawaiian grasses are given below.

The only species that is strictly a strand plant is *Sporobolus virginicus* found on sandy shores such as the vicinity of Kahuku on Oahu. This is a low perennial with extensively creeping rhizomes, short, sharp, distichous leaves and spikelike panicles. It is found from Virginia to Brazil and also in the tropics of the Old World from Africa to India and Australia. *Lepturus repens* is also a strand plant of the South Pacific islands but does not reach the main group of the Hawaiian islands, having been collected only on Palmyra and Midway islands.

The grasslike vegetation of marshland is made up chiefly of sedges (Cyperaceae). An introduced grass, *Echinochloa crusgalli crus-pavonis*, is found in taro patches, rice fields, and along ditches. An allied species, *E. colonum*, is found in wet places but is scarcely a marsh grass. In moist cultivated soil it is a weed.

The commoner species of weeds in cultivated soil are *Syntherisma sanguinalis* (crab grass) and a more delicate allied species, *S. chinensis*. In sandy fields *Cenchrus hillebrandianus* (sandbur) is abundant.

Characteristic pasture land is found in the interior of Oahu in the vicinity of Schofield Barracks. The most abundant species of grasses at Schofield is *Rhaphis aciculata*, called by the Hawaiians pilipiliula (Pl. XXXI C. and fig. 107). It is a creeping pestiferous little grass whose sharp-pointed fruits penetrate the clothing and cause annoyance. Other species found in pasture land are *Sporobolus elongatus*, *Agrostis retrofracta*, and *Chaetochloa geniculata*. All these species are aggressive weeds which, with the possible exception of *Agrostis retrofracta*, have been introduced.

The weeds of streets are often found in fields and those of fields are found along streets, but certain species are characteristic of the streets and waste places about Honolulu and the larger towns. *Capriola dactylon*, Bermuda grass, manienie of the Hawaiians, is abundant in dry open ground. It is also found in pasture land, generally where the soil is not too wet or the rainfall too great. Bermuda is a common lawn grass. *Eleusine indica*, goose grass, and two species of *Chloris*, *C. paraguayensis* and *C. radiata*, are not uncommon.

There are two species of grass dominant on open or partially wooded slopes below the forest in the wet parts of the islands. These are *Paspalum orbiculare* and *P. conjugatum*. Both are introduced and neither is of value as a forage grass. *Paspalum conjugatum* is locally known as Hilo Grass; in the West Indies it is called sour grass.

Practically all the species mentioned thus far are introduced. The native species appear in the more remote regions.

² Hillebrand, William, (1) The flora of the Hawaiian Islands, New York and Heidelberg, 1888; (2) Die Vegetationsformationen der Hawaiischen Inseln: Engler Bot. Jahrb. Vol. 9, pp. 305-314, 1887.

³ Rock, Joseph F., Indigenous trees of the Hawaiian Islands, Honolulu, 1913.

⁴ Heller, A. A., Plants of the Hawaiian Islands: Minnesota Geol. and Nat. Hist. Survey Bull. 9 (Minn. Botanical Studies Vol. 1), pp. 765-777, 1894-1898.

The most characteristic species of lee side slopes and plains here are several annual sorts of *Panicum*, such as *P. torridum*, *P. beecheyi*, *P. nubigenum*, and *P. lanaiense*. These are all annuals that spring up abundantly after the winter rains. The Hawaiian name for these is kakonakona.

On dry rocky slopes such as the sides of Punch Bowl in Honolulu is found *Heteropogon contortus*, a common useful native perennial. The Hawaiian name is pili grass. It was used by the natives to thatch their huts (Pl. XXXI, A.) and is, furthermore, a good forage grass. It extends over much of the drier region of the Hawaiian islands and formerly occupied much of the land now in cultivation.

Grasses are practically absent from the deep forest. *Oplismenus hirtellus* is a shade grass found in the mountains where the shade is not too deep. It is a creeping grass with lanceolate thin blades conspicuously different from the ordinary long, narrow leaves of most grasses. The native name is honohono, which is also applied to a common species of *Commelina*. *Isachne distichophylla* (fig. 92) is found in somewhat open woods. It is frequent in the vicinity of the Crater Hotel near Kilauea. The other species, *I. pallens*, is found on wet rocks, as in the vicinity of waterfalls. *Panicum kaalaense* (fig. 80), a robust species, is found on the forested slopes of Mt. Kaala and in similar situations. A characteristic grass of dry woods is *Eragrostis grandis*, a robust species in large bunches, 1 to 1.5 meters tall. It is found, for example, on the wooded slopes of the mountains west of Schofield Barracks. *Panicum nephelophilum*, *P. tenuifolium*, and *P. xerophilum* are also found in dry open woods.

The dominant grass on many of the ridges of the foothills behind Honolulu is *Eragrostis variabilis*. This species is common on the grassy slopes at the Nuuanu Pali (Pl. XXXI, B).

An extensive plain lies between Mauna Kea, Mauna Loa, and the Hualalai Mountains on the island of Hawaii. The dominant grasses are *Eragrostis atropioides* and *E. leptophylla*. They form erect tufts over large areas.

Toward the upper limit of vegetation on the high mountains of Hawaii, above timber line and extending down into the upper open forest, are three common species of grasses, *Trisetum glomeratum*, *Agrostis sandwicensis*, and *Aira nubigena* (Pl. XXXII).

The open bogs are peculiar and interesting formations found at or near the summits of mountains that rise to the height of approximately 5000 feet. These bogs are described by Professor Rock in his admirable book, "The Indigenous Trees of the Hawaiian Islands." They are found on Kauai, Molokai, and West Maui, and also on the Kohala Mountains of Hawaii, but are absent from the higher mountains of that island.

The bogs are devoid of trees, and also of shrubs of any considerable height, though there may be islands or intrusions of woody plants. Many of the species are tussock-forming, a conspicuous one being *Oreobolus furcatus*, a sedge. There are two common tussock-forming grasses, *Panicum imbricatum* and *P. isachnoides*. Other grasses found in these bogs are *Agrostis fallax*, *Calamagrostis hillebrandiana*, *C. expansa*, *Panicum hillebrandianum*, and *Aira nubigena*. The last men-

tioned is a variable species, which is found in other forms, under various conditions, from the moist spray of Rainbow Falls to the upper slopes of Mauna Kea.

AGRICULTURAL GRASSES.

The most important grass grown in the Hawaiian islands is the sugar cane, *Saccharum officinarum*. Corn, *Zea mays*, is grown in considerable quantity on the Parker Ranch, Hawaii. Rice, *Oryza sativa*, is a commercial product of importance. The small grains, wheat, oats, barley, and rye, have been grown by the United States Agricultural Experiment Station but are not commercially established.

Next to sugar, the most important industry on the Hawaiian Islands is stock-raising. This is carried on chiefly on the islands of Hawaii, Molokai (see Pl. XXXIII, B), Maui, and Lanai, and more particularly on the dry lee side of the islands. The growing of forage grasses has interested the planters here in recent years, for the native forage has become depleted to such an extent that it is necessary to consider supplementary cultivated forage.

Several of the meadow grasses of Europe and the United States have been tried on the ranches, and at medium altitudes give promise of success. Specimens of the following were found growing at altitudes of 3000 to 6000 feet on the Kukaiau Ranch and Parker Ranch on Hawaii, the Molokai Ranch on Molokai, the Haleakala Ranch on East Maui, and the Lanai Ranch: orchard grass (*Dactylis glomerata*); rescue grass (*Bromus unioloides*); blue grass (*Poa pratensis*); Italian rye grass (*Lolium multiflorum*); velvet grass (*Notholcus lanatus*); tall oat grass (*Arrhenatherum elatius*); redtop (*Agrostis stolonifera*); sweet vernal grass (*Anthoxanthum odoratum*).

Of these the orchard grass, rescue grass, and the rye grass are most likely to prove satisfactory.

Paspalum dilatatum is becoming established in the same region. Mr. G. C. Munro, manager of the Lanai Ranch, states that this is the most satisfactory pasture grass he has tried. He takes pains to scatter the seed from mature plants whenever he has the opportunity. There was a fine field of this at the United States Agricultural Substation at Haiku, Maui (Plate XXXIV, A).

Two tropical forage grasses may give satisfactory results at the lower altitudes. These are Pará grass (*Panicum barbinode*) and Guinea grass (*P. maximum*). They would not thrive at the higher altitudes, as they are strictly tropical and will not withstand frost. Pará grass requires plenty of moisture and would not thrive in the dry areas.

The two grasses that have proved satisfactory for hay in the dry regions are Rhodes grass (*Chloris gayana*) and Natal grass, or Natal redtop (*Tricholaena rosea*). There is a fine field of the first on the ranch of Mr. Robert Hind at Puu Waawaa, and of the second on the Molokai Ranch at Mr. George Cooke's place.

Bermuda grass is common throughout the Islands in dry open ground. It is an excellent pasture grass and also the best lawn grass for the region.

Several grasses have been tried at the United States Agricultural Experiment Station, Honolulu. *Andropogon nodosus*, *A. sericeus*, and *A. saccharoides* are promising. In the vicinity of the station these grasses have shown their adaptability by escaping from cultivation.

Sudan grass, a kind of sorghum, has been tried and has shown its adaptability. An excellent field of Sudan grass grown for hay was seen at the United States Agricultural Substation at Haiku (Pl. XXXIII, *A*).

INTRODUCED SPECIES OF GRASSES.

A large proportion of the grasses of the Islands have been introduced from other countries, mostly from Europe, a few from Australia and the East Indies. The native species are of special interest because of the unusual isolation of the islands. Many species are endemic, and most of the others have extended northward to Hawaii from the East Indies and the southern Polynesian islands.

The following species appear to be introduced, some being well established, others being recent escapes from cultivation or mere waifs. Those with an asterisk [*] were probably introduced for trial as forage or lawn grasses and have escaped from cultivation. Perennial species are followed by P.

SPECIES NATIVE IN EUROPE.

<i>Bromus hordeaceus</i>	<i>Lolium temulentum</i>	<i>Gastridium ventricosum</i>
<i>molliformis</i>	<i>multiflorum</i> * P	<i>Capriola dactylon</i> P
<i>racemosus</i>	<i>Avena sativa</i> *	<i>Anthoxanthum odoratum</i> * P
<i>rigidus gussonei</i>	<i>fatua</i>	<i>Phalaris paradoxa</i>
<i>Festuca bromoides</i>	<i>barbata</i>	<i>minor</i>
<i>Panicularia fluitans</i> P	<i>Arrhenatherum elatius</i> * P	<i>Syntherisma sanguinalis</i>
<i>Poa annua</i>	<i>Aspris caryophylla</i>	<i>Echinochloa colonum</i>
<i>compressa</i> P	<i>Notholcus lanatus</i> * P	<i>Panicum repens</i> P
<i>pratensis</i> * P	<i>Agrostis verticillata</i> P	<i>Chaetochloa verticillata</i>
<i>Briza minor</i>	<i>stolonifera</i> * P	<i>lutescens</i>
<i>Eragrostis cilianensis</i>	<i>canina</i> * P	<i>Holcus halepensis</i> P
<i>Dactylis glomerata</i> * P	<i>Polypogon monspeliensis</i>	<i>sorghum</i> *
<i>Hordeum murinum</i>	<i>lutosus</i> P	

SPECIES NATIVE IN THE UNITED STATES.

<i>Festuca megalura</i>	<i>Agrostis exarata microphylla</i>	<i>Bouteloua curtipendula</i> * P
<i>Eragrostis caroliniana</i>		<i>Phalaris californica</i> P

SPECIES NATIVE IN THE WEST INDIES AND SOUTH AMERICA.

<i>Bromus unioloides</i> *	<i>Paspalum distichum</i> P	<i>Oplismenus hirtellus</i> P
<i>Chloris paraguayensis</i>	<i>conjugatum</i> P	<i>Echinochloa crusgalli crus-pavonis</i>
<i>radiata</i>	<i>dilatatum</i> * P	<i>Chaetochloa geniculata</i> P
<i>Valota insularis</i> P	<i>Paspalum larrañagai</i> P	<i>Cenchrus echinatus</i>
<i>Paspalum fimbriatum</i>	<i>Panicum barbinode</i> * P	<i>Andropogon saccharoides</i> * P

SPECIES NATIVE IN AFRICA.

<i>Chloris gayana</i> * P	<i>Panicum maximum</i> * P
<i>Eragrostis abyssinica</i> *	<i>Tricholaena rosea</i> * P

SPECIES NATIVE IN AUSTRALIA, EAST INDIES, AND SOUTHERN ASIA.

Schizostachyum glaucifolium P	Dactyloctenium aegyptium	Sacciolepis contracta
Eragrostis amabilis	Chloris truncata P	Chaetochloa palmifolia P
falcata	Syntherisma longiflora	Andropogon intermedius* P
brownii P	chinensis	sericeus* P
Sporobolus elongatus P	debilis	nodosus* P
diander P	microbachne	Rhaphis aciculata P
Eleusine indica	Paspalum orbiculare P	Coix lachryma-jobi* P

SPECIES NATIVE IN HAWAII.

Festuca hawaiiensis P	Calamagrostis hillebrandiana P	Panicum xerophilum P
Poa mannii P	expansa P	tenuifolium P
siphonoglossa P	Agrostis fallax P	isachnoides P
sandwicensis P	sandwicensis P	imbricatum P
Eragrostis atropioides P	Garnotia sandwicensis P	hillebrandianum P
mauiensis P	Panicum fauriei	forbesii P
deflexa P	beecheyi	cynodon P
grandis P	torridum	Isachne pallens P
monticola P	nubigenum	distichophylla P
leptophylla P	kauaiense	Dissochondrus biflorus P
variabilis P	pellitum	(genus endemic)
Trisetum glomeratum P	lanaiense	Cenchrus agrimonioides P
Aira nubigena P	nephelophilum P	Ischaemum byrone P
	kaalaense P	

SPECIES PROBABLY NATIVE BUT FOUND ALSO IN REGIONS TO THE SOUTHWEST.

Lepturus repens P, a strand grass.	Stenotaphrum secundatum, also in American
Agrostis retrofracta P, may be introduced.	tropics.
Sporobolus virginicus P, a strand grass.	Cenchrus hillebrandianus, possibly introduced.
Microlaena stipoides P	Heteropogon contortus P, also in American
Syntherisma pruriens, possibly introduced.	tropics.

SUMMARY.

Native species		
Endemic	39	
Not endemic	8	47

Introduced		
From Europe	38	
From United States	5	
From West Indies and So. America	15	
From Africa	4	
From Australasia	21	83

Of the 83 introduced species 39 are perennial and 20 are probably escapes from cultivation.

Of the 47 native species 9 are annuals and of the 39 endemic species 7 are annuals, all belonging to the genus Panicum.

KEYS.

KEY TO THE TRIBES.

Subfamily Poatae. Spikelets 1 to many-flowered, the reduced florets, if any, above the perfect florets (except in Phalarideae); articulation usually above the glumes; spikelets usually more or less laterally compressed.

Plants woody, the culms perennial; spikelets several-flowered..... **BAMBOSEAE.**
Plants herbaceous, the culms annual.

Spikelets with 2 staminate, neuter, or rudimentary lemmas unlike and below the fertile lemma; no sterile or rudimentary florets above..... **PHALARIDEAE.**

Spikelets without sterile lemmas below the perfect floret.

Spikelets sessile on a usually continuous rachis.

Spikelets on opposite sides of the rachis; spike terminal, single..... **HORDEAE.**

Spikelets on one side of the rachis; spikes usually more than 1, digitate or racemose **CHLORIDEAE.**

Spikelets pedicellate in open or contracted, sometimes spikelike, panicles.

Spikelets 1-flowered..... **AGROSTIDEAE.**

Spikelets 2- to many-flowered.

Glumes as long as the lowest floret, usually as long as the spikelet; lemmas awned from the back (spikelets sometimes awnless in *Trisetum*) **AVENEAE.**

Glumes shorter than the first floret; lemmas awnless or awned from the tip or from a bifid apex..... **FESTUCEAE.**

Subfamily Panicatae. Spikelets with one perfect terminal floret (disregarding those of the few monoecious genera and the staminate and neuter spikelets) and a sterile or staminate floret below (perfect in *Isachne* and *Dissochondrus*), commonly represented by a sterile lemma only, one glume sometimes wanting; articulation below the spikelets, either in the pedicel, in the rachis, or at the base of a cluster of spikelets, the spikelets falling entire, singly, in groups, or together with joints of the rachis; spikelets, or at least the fruits, more or less dorsally compressed.

Glumes membranaceous, the sterile lemma like the glumes in texture; fertile lemma and palea indurate or at least firmer than the glumes..... **PANICEAE.**

Glumes indurate; fertile lemma and palea hyaline or membranaceous, the sterile lemma like the fertile one in texture.

Spikelets unisexual, the pistillate below, the staminate above, on the same inflorescence; the pistillate (in our species) enclosed in a bony ovoid involucre or head..... **TRIPSACEAE.**

Spikelets in pairs, one sessile and perfect, the other pedicellate and usually staminate or neuter (perfect in *Ischaemum*)..... **ANDROPOGONEAE.**

KEY TO THE GENERA.

BAMBOSEAE.

A single genus in the Hawaiian Islands.....1. *SCHIZOSTACHYUM* (p. 110)

FESTUCEAE.

Lemmas 3-nerved7. *ERAGROSTIS* (p. 123)

Lemmas 5 to many-nerved.

Lemmas as broad as long, the margins outspread; florets closely imbricate, horizontally spreading6. *BRIZA* (p. 123)

Lemmas longer than broad, the margins clasping the palea; florets not horizontally spreading.
Lemmas keeled on the back.

Spikelets strongly compressed, crowded in one-sided clusters at the ends of the stiff, naked panicle branches.....8. *DACTYLIS* (p. 137)

Spikelets not strongly compressed, not crowded in one-sided clusters.

Lemmas awned from a minutely bifid apex (awnless or nearly so in *Bromus unioloides*); spikelets large.....2. *BROMUS* (p. 111)

Lemmas awnless; spikelets small.....5. *POA* (p. 117)

Lemmas rounded on the back, sometimes slightly keeled toward the summit.

Nerves of the lemma parallel, not converging at the summit or but slightly so; lemmas awnless, mostly obtuse.....4. *PANICULARIA* (p. 116)

Nerves of the lemma converging at the summit; lemmas awned or pointed.

Lemmas entire, awned from the tip or pointed.....3. *FESTUCA* (p. 115)

Lemmas awned or awn-tipped from a minutely bifid apex.....2. *BROMUS* (p. 111)

HORDEAE.

Spikelets more than 1 at each node of the rachis.....9. *HORDEUM* (p. 139)

Spikelets solitary at each node of the rachis.

Spikelets several-flowered in flat spikes.....10. *LOLIUM* (p. 139)

Spikelets 1-flowered in cylindric spikes.....11. *LEPTURUS* (p. 141)

AVENEAE.

Florets 2, one perfect, the other staminate.

Lower floret staminate, the awn twisted, geniculate, exserted.....14. *ARRHENATHERUM* (p. 143)

Lower floret perfect, awnless; awn of upper floret hooked.....17. *NOTHOLCUS* (p. 147)

Florets 2 or more, all alike except the reduced upper ones.

Spikelets large, the glumes over 1 cm. long.....13. *AVENA* (p. 142)

Spikelets less than 1 cm. long.

Lemmas keeled, bidentate; awn arising from above the middle (sometimes wanting.)

.....12. *TRisetum* (p. 141)

Lemmas convex; awn from below the middle.

Rachilla prolonged behind the upper floret; lemmas truncate and erose-dentate at summit; plants perennial.....15. *AIRA* (p. 143)

Rachilla not prolonged; lemmas tapering into 2 slender teeth; plants annual.....

.....16. *ASPRIS* (p. 145)

AGROSTIDEAE.

Rachilla articulate below the glumes, these falling with the spikelet; glumes awned; lemmas awned from the tip.

Spikelets pilose at base, in narrow loose simple panicles.....20. *GARNOTIA* (p. 155)

Spikelets not pilose at base, in dense spikelike panicles.....21. *POLYPOGON* (p. 155)

Rachilla articulate above the glumes.

Glumes not longer than the lemma, unequal; spikelets awnless.....23. *SPOROBOLUS* (p. 157)

Glumes longer than the lemma, about equal.

Glumes saccate at base; lemma long-awned; inflorescence contracted, shining.....

.....22. *GASTRIDIVM* (p. 157)

Glumes not saccate at base.

Florets bearing at base a tuft of hairs.....18. *CALAMAGROSTIS* (p. 147)

Florets without hairs at base.....19. *AGROSTIS* (p. 149)

CHLORIDEAE.

Spikelets with more than 1 perfect floret.

Rachis not prolonged.....24. *ELEUSINE* (p. 159)

Rachis of spike extending beyond the spikelets.....25. *DACTYLOCTENIVM* (p. 161)

- Spikelets with only 1 perfect floret, often with additional imperfect florets above.
 Rachilla prolonged but with no imperfect florets.....26. *CAPRIOLA* (p. 161)
 Rachilla bearing 1 or more modified florets above the perfect one.
 Spikes digitate or nearly so.....27. *CHLORIS* (p. 163)
 Spikes racemose along the main axis.....28. *BOUTELOUA* (p. 165)

PHALARIDEAE.

- Glumes much shorter than the spikelet.....29. *MICROLAENA* (p. 167)
 Glumes not shorter than the spikelet.
 Lateral florets consisting of awned hairy sterile lemmas exceeding the fertile floret; spikelet terete30. *ANTHOXANTHUM* (p. 167)
 Lateral florets reduced to small awnless scalelike lemmas; spikelets much compressed laterally31. *PHALARIS* (p. 169)

PANICEAE.

- Spikelets sunken in the cavities of the flattened corky rachis.....34. *STENOTAPHRUM* (p. 177)
 Spikelets not sunken in the rachis.
 Spikelets subtended or surrounded by 1 to many distinct or more or less connate bristles, forming an involucre.
 Bristles united into a burlike involucre, the bur falling entire....44. *CENCHRUS* (p. 209)
 Bristles not united, persistent, the spikelets deciduous.
 Lower floret sterile.....42. *CHAETOCHLOA* (p. 205)
 Lower floret fertile.....43. *DISSOCHONDRIUM* (p. 209)
 Spikelets not subtended by bristles.
 Glumes or sterile lemma awned (awn short and concealed in the silky hairs of the spikelet in *Tricholaena*, awn reduced to a point in *Echinochloa colonum*).
 Inflorescence paniculate; spikelets silky.....41. *TRICHOLAENA* (p. 204)
 Inflorescence of unilateral simple or somewhat compound racemes along a common axis; spikelets smooth or hispid, not silky.
 Blades lanceolate, broad and thin; glumes 2-lobed, awned from between the lobes39. *OPLISMENUS* (p. 201)
 Blades long and narrow; glumes awned from the tip.....40. *ECHINOCHLOA* (p. 202)
 Glumes and sterile lemma awnless.
 Fruit cartilaginous-indurate, flexible, usually dark colored, the lemma with more or less prominent white hyaline margins, these not inrolled.
 Spikelets covered with long silky hairs, arranged in racemes, these panicle.....32. *VALOTA* (p. 170)
 Spikelets glabrous or variously pubescent, but not long-silky, arranged in slender racemes, more or less digitate at the summit of the culms.....33. *SYNTHESISMA* (p. 170)
 Fruit chartaceous-indurate, rigid.
 Fertile florets 2 in each spikelet.....38. *ISACHNE* (p. 201)
 Fertile floret 1 in each spikelet.
 First glume typically wanting (sometimes found in *P. distichum*); spikelets plano-convex, subsessile in spikeletlike racemes.....35. *PASPALUM* (p. 177)
 First glume present; spikelets usually in panicles.
 Second glume inflated-saccate, this and the sterile lemma much exceeding the stipitate fruit.....37. *SACCOLEPIS* (p. 199)
 Second glume not inflated-saccate.....36. *PANICUM* (p. 181)

ANDROPOGONEAE.

- Spikelets all perfect; inflorescence of 2 straight digitate racemes.....45. *ISCHAEMUM* (p. 213)
 Spikelets not all perfect, the sessile perfect, the pediceled staminate or rudimentary.
 Fertile spikelet with a hairy-pointed callus, formed of the attached supporting rachis joint or pedicel.

- Racemes reduced to a single joint, long-peduncled in a simple contracted panicle.....48. RHAPHIS (p. 219)
 Racemes of several to many joints, solitary.....49. HETEROPOGON (p. 221)
 Fertile spikelet without a callus, the rachis disarticulating immediately below the spikelet;
 awns slender.
 Racemes of several to many joints, solitary, digitate, or aggregate.....46. ANDROPOGON (p. 215)
 Racemes reduced to one or few joints, these mostly peduncled in a subsimple or com-
 pound panicle47. ZOLCUS (p. 217)

TRIPSACEAE.

- A single genus (besides the cultivated corn) in the Hawaiian islands.....50. COIX (p. 222)

DESCRIPTION OF THE GENERA AND SPECIES.

1. SCHIZOSTACHYUM Nees.

Spikelets slender, cylindric; glumes narrow, usually mucronate; lemmas 2 to 3, the lower 1 or 2 sterile and like the glumes in appearance, the fertile 1 or 2, much imbricate and convolute; palea similar to the lemma, convolute, not keeled; rachilla prolonged and bearing a rudimentary floret; lodicules usually 3, narrow, lanceolate, ciliolate; stamens 6; ovary narrow, with a long style and 3 stigmas; caryopsis ovoid, beaked, inclosed in a crustaceous separate pericarp. Arborescent or shrubby usually erect bamboos with panicles of spicate branches, bearing heads of spikelets, in some species reduced to a spike of heads.

1. *Schizostachyum glaucifolium* (Rupr.) Munro, Trans. Linn. Soc. 26:137. 1868.

Bambusa glaucifolia Rupr. Mém. Acad. St. Pétersb. VI. Sci. Nat. 3¹:147. 1839.

Culms erect, as much as 6 cm. thick at base, the culm-sheaths 10 cm. broad; foliage-blades linear-oblong, as much as 30 cm. long and 3.5 cm. wide, rather abruptly contracted at the base into a petiole about 5 mm. long, narrowed at apex to a fine involute point, glabrous, or scaberulous on the upper surface near the apex, the margin glabrous or scabrous, the midrib whitish and rather prominent below, the primary veins about 10 pairs; sheaths glabrous, the throat glabrous; ligule a short firm ridge less than 1 mm. long, slightly ciliate; inflorescence on clusters of slender branches from the nodes; spikelets in heads, spicate or paniculate along the branches, the heads about 2 cm. in diameter, in many specimens contiguous, the whole branch 30 to 40 cm. long; spikelets fusiform-cylindric, about 1 cm. long, pale, tawny or stramineous, 2 or 3 in the axils of bracts, the bracts similar to the glumes but longer.

The three specimens cited are floriferous but the spikelets are all sterile and show no stamens or pistils. They may not be correctly referred to *S. glaucifolium* but are the same as Munro's specimen. Munro⁵ remarks that the specimen examined by him, this or a duplicate being in the Gray Herbarium (Tahiti, Wilkes Exped.), was in the same condition. The spikelets are sessile, 2 or 3 together, bearing 4 bracts, each successively longer, the first 3 similar, convolute, nerved, mucronate, the fourth very slender, tightly rolled and much convolute. There appears to be no prolongation of the rachilla.

Munro's reference to locality is ambiguous: "Hab. in insulis Oceani Pacifici, Tahiti, Hawaii! Wilkes (florif.), no. 130, Guillemín, ('Ovhe', incolis) Bertero, Moehroch; Fiji ('Bitu' incolis), 694! Seemann; Samoa, Fiji, Wilkes; Nukahiva, Kyber." He further states that he has "seen only one flowering specimen of this

⁵ Munro, Colonel, Monograph of the Bambusaceae: Linn. Soc., London, Trans. Vol. 26, p. 137, 1868.

plant, which was collected at Tahiti in Wilkes's Expedition." From this it is not clear who collected the Hawaiian specimen. In the United States National Herbarium is a specimen (leaves only) collected by the Wilkes Expedition at Sandalwood Bay, Fiji Islands. Hillebrand mentions a small bamboo, without flowers, which he refers to this species. The species was originally described from Nukuhiva, an island of the Marquesas group.

Oahu: Kahauiki Valley, Forbes 1191.

Maui: Nahiku, Rock in 1911.

Hawaii: Hilo, Newell in 1917—"the wild-growing kind."

Bambos vulgaris Schrad.; Wendl. Coll. Pl. 2:26. pl. 47. 1810, the common bamboo, is frequently cultivated and may become established.

2. BROMUS L.

Spikelets several to many-flowered, the rachilla disarticulating above the glumes and between the florets; glumes unequal, acute, the first 1 to 3 nerved, the second commonly 3 to 5-nerved; lemmas convex on the back or keeled, 5 to 9-nerved, 2-toothed at the apex, awnless or usually awned from between the teeth; palea usually shorter than the lemma. Annual or perennial, low or rather tall grasses, with closed sheaths, flat blades, and open or contracted panicles of large spikelets.

The species in the Hawaiian islands are all introduced annual weeds, at present not common, but may in the future spread rapidly in the drier parts of the islands.

Spikelets strongly flattened; lemmas acuminate or short-awned..... 1. **B. unioloides.**

Spikelets not strongly flattened; lemmas long-awned.

Panicle contracted, erect, oblong; lemmas pubescent.

Awns straight; hairs of lemma straight and appressed..... 2. **B. hordeaceus.**

Awns bent; hairs of lemma spreading and more or less flexuous..... 3. **B. molliformis.**

Panicle open; lemmas glabrous or scabrous.

Awns less than 1 cm. long..... 4. **B. racemosus.**

Awns more than 2 cm. long..... 5. **B. rigidus gussonei.**

1. **Bromus unioloides** H. B. K. Nov. Gen. & Sp. 1:151. 1816.

Culms 50 to 100 cm. tall; sheaths pilose; blades narrow, scabrous or pilose; panicle open, 20 to 40 cm. long; spikelets compressed, 2 to 3 cm. long, 5 to 9 mm. wide; glumes glabrous, the first 5-nerved, 7 to 10 mm. long, the second 7-nerved, 10 to 12 mm. long; lemmas subcoriaceous, glabrous or scabrous, compressed and keeled, several-nerved, 12 to 15 mm. long, gradually acuminate or extending into an awn as much as 2 mm. long.

A weed in pastures and open ground; introduced. Native country not certainly known, but probably the Andes. Now distributed from Chile to southern United States. Originally described from Ecuador. This species is cultivated occasionally in the southern United States as a forage plant under the name of rescue grass or Schrader's brome grass. It was probably introduced in the Hawaiian islands for trial as a pasture grass on the ranches of the drier parts of the islands.

Molokai: Central part, 3000 feet, Hitchcock 15156.



FIGURE 1.—*Bromus hordeaceus*. From U. S.
Dept. Agr. Div. Agrost. Bull. 17, fig. 585.



FIGURE 2.—*Bromus racemosus*. From U. S.
Dept. Agr. Div. Agrost. Bull. 23, fig. 2.



FIGURE 3.—*Festuca bromoides*. From Palmer
2041 in 1892, California.

Hawaii: Puu Waawaa, Hitchcock 14464. Parker Ranch, Makahalau, Rock 8407.
Kukaiau Ranch, 3600 feet, Hitchcock 14211.

2. **Bromus hordeaceus** L. Sp. Pl. 77. 1753.

Culms 20 to 60 cm. tall; sheaths retrorsely softly pilose-pubescent; blades usually pubescent; panicle contracted, erect, 5 to 10 cm. long or in depauperate plants reduced to a few spikelets; glumes broad, obtuse, coarsely pilose or scabrous-pubescent, the first 3 to 5-nerved, 4 to 6 mm. long, the second 5 to 7-nerved, 7 to 8 mm. long; lemmas broad, obtuse, 7-nerved, coarsely appressed-pilose or scabrous-pubescent, rather deeply bidentate, 8 to 9 mm. long, the margin and apex hyaline; awn rather stout, 6 to 9 mm. long (fig. 1).

A weed in pastures and waste places at upper elevations; introduced. Originally described from Europe.

Kauai: Without locality, Rock 5128.

Hawaii: Humuula Sheep Station, 6000 feet, Hitchcock 14434.

3. **Bromus molliformis** Lloyd, Fl. Loire Inf. 315. 1844.

A low branching grass, the culms 10 to 30 cm. tall; sheaths pubescent; blades narrow, pubescent; panicle short and dense, mostly not over 5 cm. long; spikelets 1.5 to 2.5 cm. long; glumes 10 to 12 mm. long, pubescent; lemmas about 1 cm. long, the pubescence more or less spreading and flexuous; awns of the lower florets short, of the upper 5 to 10 mm. long and at maturity or in dried specimens, spreading.

A weed in fields and waste places; introduced. Originally described from Spain.

Oahu: Schofield Barracks, Hitchcock 13914, 13975. Honolulu, weed along car line, Fort Shafter, Hitchcock 13844.

4. **Bromus racemosus** L. Sp. Pl. ed. 2. 1:114. 1762.

Resembles *B. hordeaceus*, but the panicle more open and the spikelets scabrous only, not pubescent (fig. 2).

A weed in pasture land; introduced. Originally described from Europe.
Hawaii: Kukaiau Ranch, 4000 feet, Hitchcock 14266.

5. **Bromus rigidus gussonei** (Parl.) Coss. & Dur. Expl. Sci. Alger, 2:159. 1867.

Bromus maximus gussonei Parl. Fl. Ital. 1:407. 1848.

Bromus villosus gussonei Aschers. & Graebn. Syn. Mittleur. Fl. 2:595. 1901.

Bromus villosus Forsk. 1775 is invalidated by *B. villosus* Scop. 1772.

Bromus maximus Desf. 1798 is invalidated by *B. maximus* Gilib. 1792.

Culms 40 to 60 cm. tall; sheaths and blades pilose; panicle open, rather few-flowered, 8 to 15 cm. long, the lower branches 4 to 5 cm. long; spikelets usually 5 to 7-flowered, 3 to 5 cm. long; glumes smooth, narrow, acuminate, the first 15 to 20 mm. long, 1-nerved, the second 25-30 mm. long, 3-nerved; lemmas 5-nerved, 25 to 30 mm. long, scabrous or puberulent, 2-toothed, the teeth 3 to 4 mm. long; awns stout, straight, 3 to 5 cm. long.

A weed in fields; introduced. Originally described from Italy.

Oahu: Schofield Barracks, Hitchcock 13922.

Hawaii: Kukaiau Ranch, 3600 feet, Hitchcock 14219. Slopes of Mauna Kea, 5000 feet, Rock 8403.

Without locality: Hillebrand.



FIGURE 4.—*Festuca hawaiiensis*. From the type specimen.



FIGURE 5.—*Poa compressa*. From U. S. Dept. Agr. Div. Agrost. Bull. 17, fig. 544.

Bromus squarrosus L. Sp. Pl. 76. 1753. var. *villosus* Gmel.; Reichenb. Agrost. Germ. 32. pl. 75. f. 1599. 1834. Hillebrand⁶ includes this from Ulupalakua, Maui. Introduced from Europe.

Bromus tectorum L. Sp. Pl. 77. 1753. Hillebrand⁷ includes this from Makawao and Kula, Maui. Introduced from Europe.

3. FESTUCA L.

Spikelets few to several-flowered, the rachilla disarticulating above the glumes and between the florets; glumes narrow, acute, unequal, the first very small in some species; lemmas rounded on the back, membranaceous or somewhat indurate, 5-nerved, the nerves obscure in some species, acute or rarely obtuse, awned from the tip or rarely from a minutely bifid apex. Annual or perennial low or rather tall grasses of varied habit, the spikelets in narrow or open panicles. Plants perennial; panicle open, the branches spreading..... 1. **F. hawaiiensis.**
Plants annual; panicles narrow, the branches appressed.

Lemmas ciliate toward the apex..... 2. **F. megalura.**

Lemmas not ciliate..... 3. **F. bromoides.**

1. *Festuca hawaiiensis* sp. nov.

Plants perennial; culms tufted, erect, glabrous, about 1.5 meters tall, rather stout; sheaths glabrous, shorter than the internodes; ligule membranaceous, 1 to 2 mm. long, the margin lacerate; blades narrow, 20 to 30 cm. long, 3 to 5 mm. wide, tapering to a slender involute point and more or less involute at the base, smooth on the lower surface, scabrous on the upper; panicle open, 30 to 40 cm. long, erect, the branches in distant fascicles, the axis terete and smooth below, angled and scabrous above; branches spreading or drooping, slender, scabrous, about 5 in the lower fascicle, 8 to 15 cm. long, branching above the middle, bearing 3 to 5 spikelets on slender pedicels 5 to 10 mm. long, the upper fascicles of about 3 successively shorter branches; spikelets several-flowered, the rachilla appressed-hispidulous; glumes narrow, glabrous, scabrous on the keels near the apex, the first 1-nerved, 3 to 5 mm. long, the second 3-nerved, 6 to 7 mm. long; lemmas narrow, 7 to 9 mm. long, 1 to 1.5 mm. wide, rounded on the back, faintly 5-nerved, scabrous, acuminate or extended into an awn about 1 mm. long; palea scabrous, as long as the lemma and closely fitting to its edges (fig. 4).

Type in the U. S. National Herbarium, no. 836317, collected in rich soil on a moist wooded hill (Puu Huluhulu), Humuula Sheep Station, Hawaii, at about 2000 meters elevation, August 27, 1916, by A. S. Hitchcock (no. 14446).

The species was abundant here, growing in bunches 0.5 to 2 meters tall, apparently indigenous.

What appears to be the same species was collected in an over-ripe condition on the Hualalai Mountains, in woods at 1000 meters elevation (Hitchcock 14536).

This is the species described as *Festuca drymeia* Mert. & Koch by Hillebrand⁸ who says, "without label; probably collected in Ulupalakua, Maui." Hillebrand's specimen, kindly submitted to me by Dr. Diels, is labeled from "Maui et Hawaii." It differs from *F. drymeia* of Europe in the larger scabrous spikelets and the absence of rhizomes.

2. *Festuca megalura* Nutt. Journ. Acad. Nat. Sci. Phila., II. 1:188. 1848.

Plants annual; culms 20 to 50 cm. tall, tufted; sheaths and blades glabrous; panicle narrow, 7 to 20 cm. long, the branches appressed; spikelets 4 or 5-flowered; glumes glabrous, very unequal, the first mostly less than 2 mm. long, the second 4 to 5 mm. long; lemmas linear-

⁶ Op. cit., p. 535.

⁷ Op. cit., p. 535.

⁸ Op. cit., p. 534.

lanceolate, scabrous above, ciliate on the upper half, attenuate into an awn about twice their length.

A weed in open ground and grassland, mostly at upper altitudes; introduced. Originally described from California.

Oahu: Summit of Mt. Tantalus, Hitchcock 13868. Palehua, Waianae Range, Forbes 1686.

Hawaii: Kukaiau Ranch, 3600 feet, in pasture, Hitchcock 14210. Summit of Hualalai Mountains, Hitchcock 14530; Forbes 205. Hilo, along river near Rainbow Falls, Hitchcock 14197.

Without locality: Hillebrand.

3. ***Festuca bromoides*** L. Sp. Pl. 75. 1753.

Similar to *F. megalura* in aspect; panicle dense, 5 to 10 cm. long; glumes unequal, the first 4 mm. long, the second 6 to 7 mm. long; lemma not ciliate, 7 to 8 mm. long, the awn 10 to 12 mm. long (fig. 3).

A weed in pastures and waste places; introduced. Originally described from Europe.

Kauai: Kumuweia Ridge, west side Waimea drainage basin, Forbes 990.

Oahu: Along cliff, Nuuanu Pali, Hitchcock 13747, 13779. Schofield Barracks, Hitchcock 13939. Honolulu, Newell in 1917.

Lanai: Mountains near Koele, Forbes 102.

Maui: Wet forest along Olinda pipe line, Hitchcock 14935. Wet meadow, Haleakala crater, Hitchcock 14975.

Hawaii: Summit of Hualalai Mountains, Forbes 211. In woods, Hualalai Mountains, 5000 feet, Hitchcock 14511. Pasture, Kukaiau Ranch, 3600 feet, Hitchcock 14215. Pasture, Humuula Sheep Station, 6000 feet, Hitchcock 14435, 14436. Paauhau, Parker Ranch, Rock 3155, 3322, 3467. Mauna Kea, Moano Crater, 8000 feet, Rock 3298.

4. **PANICULARIA** Heister.

Spikelets few to many-flowered, subterete or slightly compressed, the rachilla disarticulating above the glumes and between the florets; glumes unequal, short, obtuse or acute, usually scarious, mostly 1-nerved; lemmas broad, convex on the back, firm, usually obtuse, awnless, scarious at the apex, 5 to 9-nerved, the nerves parallel, commonly prominent. Aquatic or marsh grasses, for the most part tall with flat blades, closed or partly closed sheaths, and open or contracted panicles.

1. ***Panicularia fluitans*** (L.) Kuntze, Rev. Gen. Pl. 2:782. 1891.

Festuca fluitans L. Sp. Pl. 75. 1753.

Plants perennial; culms ascending from a decumbent rooting base, rather thick and succulent, 1 to 1.5 meters tall; sheaths smooth; blades flat, 3 to 10 mm. wide, scabrous above; panicle long and narrow, 20 to 30 cm. long; spikelets single and rather distantly arranged along the upper part of the axis, 2 or 3 together on the lower short appressed branches, linear, 1.5 to 2 cm. long, 2 to 3 mm. wide, short-pedicel, many-flowered; glumes very unequal, obtuse, the second about 3 mm. long; lemmas broad, obtuse, 5 mm. long, 7-nerved, scaberulous, scarious at the apex.

Swampy ground; introduced. Originally described from Europe. Probably introduced with grass seed; other European meadow grasses are nearby. Maui: Haleakala crater, west side, about 6000 feet, Hitchcock 14996.

5. POA L.

Spikelets 2 to several-flowered, the rachilla disarticulating above the glumes and between the florets, the uppermost floret reduced or rudimentary; glumes acute, keeled, somewhat unequal, the first 1-nerved, the second commonly 3-nerved; lemmas somewhat keeled, acute or acutish, awnless, membranaceous, many somewhat scarious at the tip, 5-nerved, the nerves pubescent in some species. Annual, or usually perennial, species of low or rather tall grasses, with spikelets in open or contracted panicles, the narrow blades flat or folded, ending in a navicular point.

Plants annual; nerves of lemma villous..... 1. *P. annua*.

Plants perennial; nerves pubescent or glabrous.

Creeping rhizomes present; sheaths open.

Culms much flattened; lemmas obscurely nerved..... 2. *P. compressa*.

Culms scarcely flattened; lemmas rather strongly 5-nerved..... 3. *P. pratensis*.

Creeping rhizomes absent; sheaths closed.

Ligule deeply fimbriate..... 4. *P. mannii*.

Ligule entire or dentate, not deeply fimbriate.

Old culms as much as 3 or 4 meters long, rushlike, bearing bladeless sheaths..... 5. *P. siphonoglossa*.

Old culms not becoming elongate, leafless, and rushlike..... 6. *P. sandvicensis*.

1. *Poa annua* L. Sp. Pl. 68. 1753. ANNUAL BLUE GRASS.

Plants annual; culms flattened, decumbent at base, some rooting at the lower nodes, 10 to 30 cm. tall; sheaths loose; blades soft and lax; panicle pyramidal, open, 2 to 6 cm. long; spikelets crowded, 3 to 6-flowered, about 4 mm. long; lemma not webbed at base, distinctly 5-nerved, the nerves villous on the lower half (fig. 6).

A weed in open ground, mostly at upper elevations; introduced. Originally described from Europe.

Oahu: Nuuanu Pali, Hitchcock 13750, 13782.

Maui: Olinda pipe line, Hitchcock 14922. Ulupalakua, East Maui, Mann & Brigham 459.

Hawaii: Puu Oo, Forbes 863. Kukaiau Ranch, Hitchcock 14223, 14269. Mauna

Kea, near lake, Hitchcock 14455. Without locality, Wilkes Expl. Exped.

Without locality: Hillebrand.

2. *Poa compressa* L. Sp. Pl. 69. 1753. CANADA BLUE GRASS.

Plants perennial, with creeping rhizomes; culms scattered, not tufted, geniculate-ascending, flattened, wiry, bluish green, 15 to 40 cm. tall; panicle narrow, 2 to 7 cm. long, the commonly short branches in pairs, spikelet-bearing to the base; spikelets crowded, sessile, 3 to 6-flowered, 4 to 6 mm. long; glumes about 2 mm. long, 3-nerved; lemmas firm, obscurely nerved, 2 to 2.5 mm. long, sparingly webbed at base, short-pubescent below on the keel and marginal nerves (fig. 5).

Moist places; introduced. Originally described from Europe and North America.

Hawaii: Around water tank on way to Humuula Sheep Station, Hitchcock 14442.

3. *Poa pratensis* L. Sp. Pl. 67. 1753. KENTUCKY BLUE GRASS.

Perennial from creeping rhizomes; culms tufted, 30 to 60 cm. tall, terete or slightly flattened; sheaths smooth, compressed; ligule about 2 mm. long; blades soft, flat or folded, the basal often elongate; panicle pyramidal, open, mostly 5 to 10 cm. long, the slender branches in somewhat remote fascicles of 3 to 5, ascending or spreading, naked at base, some of them short; spikelets crowded, 3 to 5-flowered, 4 to 5 mm. long; lemmas 3 mm. long, copiously webbed at base, silky pubescent on keel and marginal nerves, the intermediate nerves prominent (fig. 7).

Grassland; introduced. Originally described from Europe.

Hawaii: Kanehaka, Kona, Forbes 263. Humuula Sheep Station, Hitchcock 14450. Kilauea, Hapeman 7.

An allied but unidentified species was collected by Rock near the lake on Mauna Kea at about 12,500 feet (no. 12737). The species is probably introduced as it has not been observed elsewhere. The locality is a stopping place on the way to the summit of Mauna Kea.

Plant appearing to produce rhizomes; sheaths retrorsely scabrous as in *Poa trivialis*; ligule short and broad, about 1 mm. long; blades flat and broad, some of them 8 mm. wide;



FIGURE 6.—*Poa annua*. From U. S. Dept. Agr.
Div. Agrost. Bull. 17, fig. 533.

panicle immature; spikelets few-flowered, the glumes acuminate, almost bristle-pointed, a little unequal, the second about 4 mm. long; lemmas copiously webbed at base, the keel and marginal nerves villous, the intermediate nerves rather obscure.

Siphonocoleus sect. nov.

Sheaths closed; ligule united at the edges forming a tube, a somewhat thickened auricle or tooth extending upwards into the ligule from the sinus of the sheath; culms flattened, solid. Type *Poa siphonoglossa* Hack. Includes three species from the Hawaiian islands. (*Siphon*, tube, *coleus*, sheath.)

4. ***Poa mannii*** Munro; Hillebr. Fl. Haw. Isl. 526. 1888.

Plants perennial without rhizomes; culms tufted, flattened, wiry, glabrous, striate, somewhat glaucous, the internodes solid; sheaths glabrous, striate, mostly shorter than the internodes, closed nearly or quite to the mouth, an auricle continued upward from the sinus for 2 to 3 mm.; ligule membranaceous, about 0.5 mm. long, the margin fimbriate, the divisions 1 to 3 mm. long; blades flat, lax, as much as 15 cm. long, mostly shorter, 2 to 4 mm. wide, acuminate, glabrous beneath, scabrous on the upper surface, somewhat clasping at the base, the lower finally deciduous from the sheaths; panicle ovate, mostly less than 5 cm. long, the lower branches about 3, ascending, bearing above the middle a cluster of spikelets; spikelets mostly 4 or 5-flowered, flattened, about 5 mm. long, pale, greenish or tawny, the rachilla nearly glabrous; glumes glabrous, narrow, acuminate, slightly unequal, about 3 mm. long, 3-nerved, the first in some spikelets faintly nerved; lemmas 3 to 4 mm. long, acute, more or less webbed at base, the keel and lateral nerves villous on the lower part, the intermediate nerves not very prominent (fig. 8).

Wet cliffs. Originally described from "Kauai, Waimea (M. & B. 274)." Kauai: Olokele Gulch, Hitchcock 15229; Faurie 1306. Waimea, 2000-3000 feet, Mann & Brigham 274 (the type collection of *Poa mannii* Munro).

The indigenous species of *Poa* are not sufficiently known. One of the specimens cited (Faurie 1306) has a few hairs in the axils of some of the branches of the inflorescence.

5. ***Poa siphonoglossa*** Hack. Repert. Nov. Sp. Fedde 11:24. 1912.

Plants perennial without creeping rhizomes; culms solid, flattened, smooth, striate, tufted, the tufts often large, depending from banks in long masses as much as 4 meters long, the old culms naked and rushlike, bearing bladeless sheaths, the internodes much elongate, as much as 65 cm. long; sheaths glabrous, closed to the mouth, shorter than the internodes, on the older culms much shorter; ligule membranaceous, more or less dentate, 2 to 3 mm. long, continuous across the mouth except where ruptured by the splitting of the sheath; blades flat, lax, mostly less than 10 cm. long, 2 to 3 mm. wide, smooth beneath, scabrous on upper surface, deciduous from the sheaths on the old culms; panicle ovate, mostly less than 5 cm. long, the lower branches about 5, ascending, the whole panicle rather few-flowered; spikelets flat, 2 to 5-flowered, 4 to 7 mm. long, the rachilla pubescent; glumes narrow, acuminate, glabrous, 3-nerved, a little unequal, the second about 4 mm. long; lemmas narrow, acute, 4 to 5 mm. long, not webby at base, scabrous on the keel and marginal nerves, or scabrous-pubescent toward the base, the intermediate nerves rather prominent; palea scabrous-ciliate on the keels, nearly as long as the lemma, 2-toothed (fig. 9).

Shady banks along a ridge. Originally described from Kauai "prope Waimea, 1000 m. s. m. et prope Holokele, Mart. 1910, leg. U. Faurie (no. 1305 et 1306)." No. 1305 may be taken as the type.

Kauai: Maulili, near Kaholuamano, Hitchcock 15536, Rock 9018.



FIGURE 7.—*Poa pratensis*. From U. S. Dept. Agr.
Bull. 772, fig. 13.



FIGURE 8.—*Poa mannii*. From Hitchcock
15229, Kauai.

This species is remarkable in its vegetative characters, and its life history needs investigation. Apparently the shoots come into flower when 30 or 40 cm. tall. At this stage the plant presents no unusual habit. The culms are leafy, the upper sheaths overlapping, the panicle rather small. Later the lower internodes elongate greatly and the lower blades fall away. But the upper part of the shoot retains its juvenile appearance. The blades are soft and lax, the uppermost sheaths are overlapping, and the panicle is somewhat larger. Finally the panicle withers and falls off, the blades drop, and the hard rushlike culm hangs down for as much as 4 meters.

Hackel bases his description of *Poa siphonoglossa* upon two specimens, Faurie 1305 and 1306. The second I have referred to *Poa mannii*, because of the fimbriate ligule and the webby callus hairs at the base of the lemmas. Hackel describes the ligule as "acute dentata haud raro ex parte in fimbria soluta". The latter part of the statement refers to Faurie 1306. The description of the lemma appears also to have been taken from this specimen, insofar as concerns the statement "callo pilis crispis mollibus 1/3-1/2 glumae aequantibus parce lanato."

Faurie's two specimens are said to come from "prope Waimea, 1000 m. s. m. et prope Holokele" [*sic*]. My number 15229 (*Poa mannii*) came from Olokele gulch near Waimea which is probably the same as the locality given by Faurie. The specimens of *Poa siphonoglossa* collected by Professor Rock came from higher up on the mountain near Kaholuamano. A specimen from this collection was submitted to Professor Hackel who identified it as *Poa siphonoglossa*. I collected my specimens (no. 15536), in company with Professor Rock, from the same locality. I here had opportunity to observe the remarkable aftergrowth of the culms. A single bunch or tuft would contain scores of culms forming a pendent mass 3 to 4 meters long. Some of the stems are as much as 5 meters long. They are mostly leafless and rushlike. (Pl. XXXV.)

The portion of Olokele Gulch traversed by the carriage road rises to only about 500 meters. It is probable that Faurie collected his *Poa mannii* (no. 1306) along this road and at the same locality that I obtained my specimens (no. 15229). The locality for our specimens of *Poa siphonoglossa* is at about 1000 to 1200 meters. It would appear from this that one specimen (no. 1305) may have come from near Kaholuamano and the other (no. 1306) from Olokele Gulch, thus agreeing with the distribution of my own specimens.

6. *Poa sandvicensis* (Reichart).

Festuca sandvicensis Reichardt, Sitzungsab. Akad. Wiss. Math. Naturw. (Wien) 76¹:726. 1878.

Poa longeradiata Hillebr. Fl. Haw. Isl. 526. 1888.

Plants perennial, without rhizomes; culms erect or decumbent, 30 to 100 cm. tall, compressed, smooth, solid; sheaths striate, keeled, retrorsely scabrous or the upper smooth, closed to the mouth or splitting with age; ligule short, firm, dentate, less than 1 mm. long, a hard tooth continued upward from the sinus of the mouth of the sheath; blades 10 to 20 cm. long, as much as 6 mm. wide, glabrous, or scabrous on the upper surface; panicle ovate, 3 to 5 cm. long, becoming later as much as 15 cm. long, the branches slender, spreading or reflexed, the lower as much as 10 cm. long, branching toward the end, bearing a few spikelets; spikelets compressed, 5 to 8 mm. long, 4 to 6-flowered, the rachilla scabrous-pubescent, glumes narrow, acuminate,

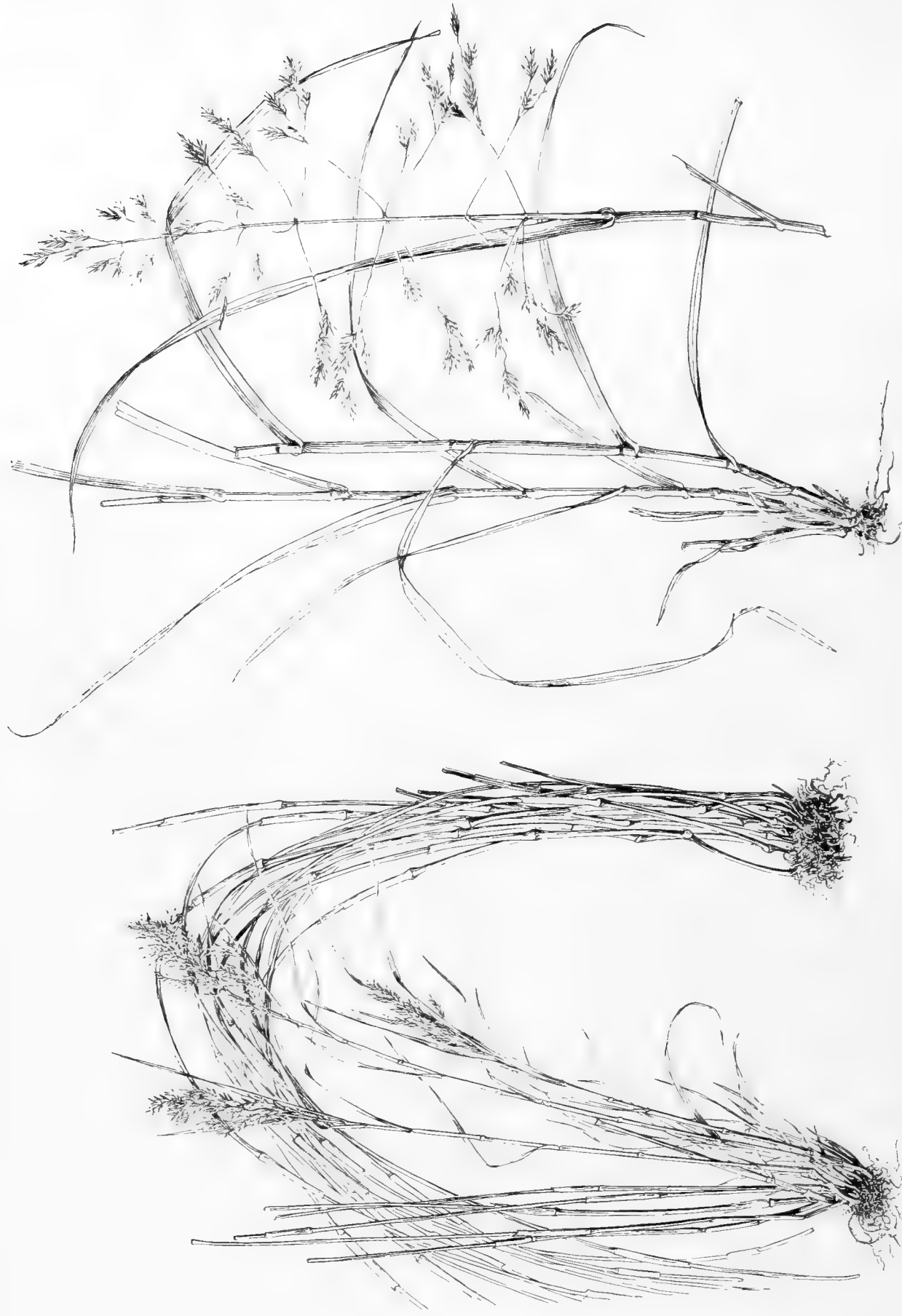


FIGURE 9.—*Poa siphonoglossa*. From Hitchcock 15536 (fertile plant), and Rock 9018 (sterile plant), Kauai.

FIGURE 10.—*Poa sandvicensis*. From Hitchcock 15309, Kauai.

scabrous on the keel, about 3 mm. long; lemmas 4 to 5 mm. long, acute, sparingly webby at base especially in the lower florets, scabrous on the keel, scabrous-pubescent on the lower part of the lateral nerves, the intermediate nerves faint; palea nearly as long as the lemma, scabrous-ciliate on the keels, 2-toothed (fig. 10).

Moist shady cliffs. Originally described from "Kauai; um Halemanu an offenen, humusreichen Stellen der Thäler nr. 2124, 2143." *Poa longeradiata* was described from "Kauai. Waimea (Kn. and M. & B. 368); Maui? gulch of Waihee."

Kauai: Kaholuamano, Hitchcock 15309; Rock 12639. Waimea, 2000-3000 feet, Mann & Brigham 368. West side ridge, west side of Kauaikinana, Forbes 796. West side Waimea drainage basin, trail down ridge to Kauaikinana, Forbes 992.

The specimens here cited differ somewhat from one another. Hitchcock's no. 15309 is a tall rather stout plant over 1 meter tall with a large panicle as much as 15 cm. long with long slender branches. The spikelets are past maturity and are mostly wanting. Forbes's no. 992 is a cluster of rather slender culms 40 cm. tall with narrow blades scarcely 2 mm. wide, and small panicles 4 to 5 cm. long. Rock's no. 12639 and Forbes no. 796 are intermediate. They all agree in the scabrous sheaths, short ligule, and the spikelet characters. The slender shoots with small panicles may be the juvenile phase.

6. *BRIZA* L.

Spikelets several-flowered, broad, often cordate, the florets crowded and spreading horizontally, the rachilla glabrous, disarticulating above the glumes and between the florets, the uppermost floret reduced; glumes about equal, broad, papery-chartaceous, with scarious margins; lemmas papery, broad, with scarious spreading margins, cordate at base, several-nerved, the nerves often obscure, the apex in our species obtuse or acutish; palea much shorter than the lemma. Annual or perennial, low grasses, with erect culms, flat blades, and for the most part open, showy panicles, the pedicels in our species capillary, allowing the spikelets to vibrate in the wind.

1. *Briza minor* L. Sp. Pl. 70. 1753. QUAKING GRASS.

An annual with erect culms 10 to 30 cm. tall; panicle erect, pyramidal, many-flowered, the main branches stiffly ascending, the capillary branchlets spreading; spikelets triangular-ovate, 3 mm. long (fig. 11).

A weed along roads and trails; introduced. Originally described from Europe.

Kauai: Olokele Gulch, Hitchcock 15210.

Oahu: Nuuanu Pali, Hitchcock 13799; Forbes 1526.

Molokai: Central part, Hitchcock 15164.

Maui: Olinda pipe line, Hitchcock 14931.

Hawaii: Paauhau, Rock 3457. Kukaiau Ranch, 3600 feet, Hitchcock 14209.

Without locality, Wilkes Expl. Exped.

7. *ERAGROSTIS* Host.

Spikelets few to many-flowered, the florets usually closely imbricate, the rachilla disarticulating above the glumes and between the florets, or continuous, the lemmas deciduous, the paleas



FIGURE 12.—*Eragrostis amabilis*. From U. S. Dept. Agr.
Div. Agrost. Bull. 7, fig. 249.



FIGURE 11.—*Briza minor*. From
Howell in 1884. Oregon.

commonly persistent; glumes somewhat unequal, shorter than the first lemma, acute or acuminate, 1-nerved, or the second rarely 3-nerved; lemmas acute or acuminate, keeled or rounded on the back, 3-nerved, the nerves as a rule prominent; palea 2-nerved, the keels in some species ciliate. Annual or perennial grasses of various habit, the inflorescence an open or contracted panicle. Plants annual; introduced species.

Palea prominently ciliate on the keels, the hairs about 0.3 mm. long.....1. **E. amabilis.**

Palea not prominently ciliate on the keels.

Lemmas glandular on the keel.....2. **E. cilianensis.**

Lemmas not glandular.

Spikelets as much as 2 cm. long, densely many-flowered.....3. **E. falcata.**

Spikelets less than 1 cm. long, loosely few to 12-flowered.

Palea remaining on the rachilla after the fall of the lemma; spikelets appressed on the branchlets.....4. **E. caroliniana.**

Palea and lemma deciduous from the rachilla; spikelets on long ascending pedicels5. **E. abyssinica.**

Plants perennial.

Creeping rhizomes short and stout, the culms in loose tufts.....6. **E. atropioides.**

Creeping rhizomes wanting, the culms in compact tufts.

Pedicels slender, straight, stiffly ascending, mostly longer than the spikelets.....

.....7. **E. mauiensis.**

Pedicels mostly shorter than the spikelets, if longer then flexuous.

Lower branch of the open panicle solitary; spikelets about 2 mm. wide.....

.....8. **E. brownei.**

Lower branches of panicle several in a fascicle, or the panicles narrow and spike-like, obscuring the fascicles.

Branches of the open panicle deflexed at maturity; blades mostly less than 4 mm. wide.....9. **E. deflexa.**

Branches of panicle not deflexed; panicle usually contracted, if open the blades mostly more than 5 mm. wide.

Plants tall and stout, usually over 1 meter tall; panicles oblong, rather open; blades flat, usually more than 5 mm. wide, in some specimens as much as 1 cm. wide.....10. **E. grandis.**

Plants mostly less than 1 meter tall, many low or slender; panicles contracted, or even spikelike.

Culms low, slender, tufted, mostly less than 30 cm. tall; blades slender, involute, mostly basal; panicles narrow but not very dense, mostly 5 to 15 cm. long.....11. **E. monticola.**

Culms tall, slender or stout, commonly as much as 1 meter tall, some lower but stout.

Culms tall and slender; blades slender, involute, about 1 mm. wide when rolled; panicles slender and spikelike, 15 to 30 cm. long12. **E. leptophylla.**

Culms stout; blades mostly more than 5 mm. wide, flat or becoming involute at the tips; panicle stout, compact or somewhat open, as much as 40 cm. long.....13. **E. variabilis.**

1. **Eragrostis amabilis** (L.) Wight & Arn.; Hook. & Arn. Bot. Beechey Voy. 251. 1841.

Poa amabilis L. Sp. Pl. 68. 1753.

Eragrostis plumosa Link, Hort. Berol. 1:192. 1827.

Plants annual; culms erect or spreading and geniculate at base, slender, 10 to 30 cm. tall, glabrous; sheaths glabrous, pilose at the throat; blades flat, lax, striate, mostly less than 10 cm. long, 2 to 4 mm. wide; panicle oblong, or elliptic, 5 to 15 cm. long, 3 to 6 cm. wide, open, the branches ascending or spreading, pilose in the axils, slender, the pedicels finally spreading, mostly as long as the spikelet or longer; spikelets 1.5 to 2 mm. long, mostly 4 to 6-flowered, the rachilla joints finally disarticulating; glumes broad, nearly equal, about 1 mm. long; lemmas obtuse, about 1 mm. long; palea as long as the lemma, prominently ciliate, the hairs straight, rather distant, about 0.3 mm. long (fig. 12).



FIGURE 13.—*Eragrostis cilianensis*. From U. S.
Dept. Agr. Bull. 772, fig. 15.



FIGURE 14.—*Eragrostis caroliniana*. From U. S.
Dept. Agr. Div. Agrost. Bull. 7, fig. 24r.

A weed in open ground; introduced. Originally described from India.
Oahu: Honolulu, Faurie in 1909; Hitchcock 13723, 14074, 13720; Newell in 1917.
Waikiki, Heller 1962.

2. **Eragrostis cilianensis** (All.) Link, Vign. Lut. Malpighia 18:386. 1904.

Poa cilianensis All. Fl. Pedem. 2:246. 1785.

Eragrostis major Host, Gram. Austr. 4:14, pl. 24. 1809.

Eragrostis megastachya Link, Hort. Berol. 1:187. 1827.

Plants annual, strong-scented when fresh; culms erect or ascending from a decumbent base, rather flaccid, freely branching, 20 to 40 cm. tall; blades 5 to 15 cm. long, 3 to 6 mm. wide; panicles greenish or lead-colored, 5 to 15 cm. long, rather densely flowered; spikelets 5 to 15 mm. long, 3 mm. wide, 10 to 40-flowered, the florets closely imbricate; the pedicels and keels of the acute glumes and lemmas sparingly glandular; lemmas thin, the lateral nerves prominent (fig. 13).

A weed in waste ground; introduced. Originally described from Italy.
Oahu: Honolulu, Newell in 1917. Waikiki, Hitchcock 13802; Heller 2288.
Without locality, Mann & Brigham 71.

3. **Eragrostis falcata** (Gaud.) Gaud.; Steud. Nom. Bot. ed. 2. 1:563. 1840.

Poa falcata Gaud. in Freyc. Voy. Uran. Bot. 408. pl. 25. 1830. [Title page dated 1826.]

Plants annual; culms tufted, wiry, 5 to 15 cm. tall, glabrous; sheaths glabrous; blades short, firm, glabrous, involute; inflorescence a raceme or simple panicle; spikelets nearly terete, 1 to 2 cm. long, 1 to 1.5 mm. wide, falcate, many-flowered, short-pedicel, the florets closely imbricate, glabrous; lemmas about 2 mm. long, strongly 3-nerved, tawny, obtuse.

Represented only by Mann & Brigham 44 from Oahu. Originally described from Australia.

4. **Eragrostis caroliniana** (Spreng.) Scribn. Mem. Torrey Club 5:49. 1894.

Poa caroliniana Spreng. Mant. Fl. Hal. 33. 1807.

Plants annual; culms erect, decumbent at base, or prostrate-spreading, 15 to 40 cm. tall, diffusely branched at base; sheaths sparingly pilose at the summit; blades 2 to 10 cm. long, 2 to 3 mm. wide; panicle diffuse, 7 to 20 cm. long, the lower axils sparingly bearded; spikelets 5 to 18-flowered, becoming linear, 4 to 8 mm. long, 1 to 1.5 mm. wide, equaling or shorter than the pedicels, appressed along the main branches; glumes 1-nerved, smooth except the keels, the first 1 mm., the second 1.5 mm. long; lemmas smooth, slightly scabrous on the keel, the lower about 1.5 mm. long, 0.5 mm. wide, the lateral nerves distinct but not prominent (fig. 14).

A weed along road; introduced. Originally described from North Carolina.
Oahu: Honolulu, Fort Shafter, Hitchcock 13843.
Hawaii: Hilo, Newell in 1917.

5. **Eragrostis abyssinica** (Jacq.) Link, Hort. Berol. 1:192. 1827.

Poa abyssinica Jacq. Misc. 2:364. 1781. (Link spells the name *abessinica*.)

Plants annual; culms erect, slender, glabrous, 50 to 80 cm. tall; sheaths glabrous, pilose at the throat; blades slender, 10 to 15 cm. long, 1 to 2 mm. wide, acuminate into a slender point; panicle oblong, open, 15 to 20 cm. long, the lower branches fascicled, pilose in the axils, as much as 10 cm. long, the axis, branches and pedicels scabrous; spikelets few-flowered, 3 to 6 mm. long, the pedicels slender; glumes acuminate, a little unequal, the lower 2 mm. long; lemmas about 2 mm. long, minutely scaberulous on the keel above, as also on the keels of the palea; caryopsis brown, turgid, oblong, about 1 mm. long, a little over 0.5 mm. wide, spreading the palea and lemma apart at maturity.



FIGURE 15.—*Eragrostis atropioides*. From Hitchcock 14459, Hawaii.



FIGURE 16.—*Eragrostis mauianensis*. From the type specimen.

Escaped from the United States Agricultural Experiment Station grounds; introduced from Africa. In the original description no locality is cited.

Oahu: Honolulu, Hitchcock 14123.

6. *Eragrostis atropioides* Hillebr. Fl. Haw. Isl. 531. 1888.

Plants perennial, in loose tufts with short hard scaly creeping rhizomes as much as 7 cm. long; culms erect, hard, glabrous, slightly scabrous below the panicle, 1 to 1.5 meters tall; sheaths glabrous, pilose on the margins especially in the sterile shoots, pilose at the throat; ligule a pilose ridge, the hairs 5 mm. long; blades elongate, 30 to 40 cm. long, 4 to 6 mm. wide, glabrous beneath, scabrous on the upper surface; panicle erect, narrow, contracted but scarcely spike-like, 25 to 50 cm. long, 2 to 4 cm. wide, the branches appressed, several at a node, some short or the spikelets sessile, others as much as 10 cm. long and naked at the base. Spikelets linear, many-flowered, as much as 2.5 cm. long, the rachilla glabrous; glumes a little unequal, 3 to 4 mm. long, acuminate, more or less scabrous on the keel; lemmas glabrous, obtuse and erose at the summit, about 2 mm. long, pale or purplish, rather closely imbricate; palea persistent, about as long as the lemma, obtuse, minutely ciliate on the keels (fig. 15).

Sandy plain between Mauna Kea and Mauna Loa, about 4000 feet. Originally described from "East Maui? (label lost), probably growing in wet places". Hillebrand also describes two varieties β and γ), one from "Hawaii or Maui," the other from "Oahu."

Hawaii: West of Humuula Sheep Station on road to Waimea, Hitchcock 14445, 14459. Puu Waawaa, Hitchcock 14493, 14495. Mauna Kea, above Waikii, Rock 8405. Parker's Ranch, Smith in 1902. Mauna Loa, Wilkes Expl. Exped.

Without locality: Hillebrand.

A specimen in the Gray Herbarium collected in the "Mts. East Maui" by the Wilkes Expedition appears to be this species.

7. *Eragrostis mauiensis* sp. nov.

Plants perennial; culms erect, cespitose, glabrous, 30 to 40 cm. tall; sheaths glabrous, slightly villous at the throat; ligule a ciliate membrane less than 0.5 mm. long; blades mostly involute, 10 to 15 cm. long, 1 to 2 mm. wide, glabrous on the lower surface, slightly villous on the upper surface near the base, tapering to a fine point; panicle oblong, open, about 30 cm. long and 5 to 7 cm. wide, the branches slender, stiffly ascending, as much as 10 cm. long, scabrous, villous in the axils, the ultimate branchlets or pedicels stiffly ascending, mostly longer than the spikelets; spikelets 7 to 10 mm. long, mostly 8 to 10-flowered, brownish yellow; glumes nearly equal, acuminate, scabrous on the keel, 1-nerved, the first a little shorter and narrower, about 2 mm. long, about as long as the lower lemma, almost awn-pointed; lemmas tapering to an obtuse point, 2 to 2.5 mm. long, obscurely scabrous on the keel near the apex, rounded on the back or keeled toward summit, faintly 3-nerved, imbricate and hiding the rachis, glabrous; palea a little shorter than the lemma, closely and minutely ciliate; grain oblong, dark brown, finely alveolate, 1.2 mm. long (fig. 16).

Type in the Gray Herbarium of Harvard University, collected on sandhills at Wailuku, Maui, Hawaiian islands, by the Wilkes Exploring Expedition.

This species resembles *Eragrostis elliottii* S. Wats. in the slender, stiffly ascending branches and pedicels, but differs in the shape of the panicle.

This appears to be the species described by Hillebrand⁹ under the name *E. mexicana* Link, the chief cited specimen of which, from Lanai, has been kindly lent to me by Dr. Diels, Director of the Botanic Garden at Berlin. The panicle is much smaller and less developed than that of the specimen in the Gray Herbarium. Hillebrand cites also a second specimen "Collected also by the U. S. E. Exped." which evidently is the same collection as the one here made the type of *E. mauiensis*. The Gray Herbarium specimen was examined by Munro and is labeled by him "*Eragrostis mexicana?* Link. *E. caerulea* Hillebrand mss." "*E. coerulescens*, Hbd. in herb." is given by Hillebrand as a synonym of *E. mexicana*. This specimen is not referable to the annual *E. mexicana*.

8. ***Eragrostis brownei*** (Kunth) Nees; Steud. Nom. Bot. ed. 2, 1:562. 1840.

Poa polymorpha R. Br. Prod. Nov. Holl. 180. 1810. Not *Poa polymorpha* Koen. 1803.

Poa brownei Kunth, Rév. Gram. 1:112. 1829.

Plants perennial; culms tufted, mostly prostrate-spreading, slender, uppermost node mostly not over 5 cm. from base, the peduncle and panicle about 15 cm. long but soon elongate and somewhat flexuous, becoming at maturity as much as 35 cm. long; sheaths glabrous, slightly pilose at the mouth; blades short, the basal forming a rosette, the uppermost culm blade about 5 cm. long, 1 to 3 mm. wide, glabrous; panicle at maturity 5 to 10 cm. long, with a few distant branches, single at the nodes, the lowermost 3 to 5 cm. long, spikelet-bearing to the base, glabrous in the axils, the main axis and the branches scabrous; spikelets compressed, 5 to 7 mm. long, 2 mm. wide, 10 to 15-flowered, short-pedicel, somewhat appressed along the branches; glumes nearly equal, acute, 1 to 1.5 mm. long; lemmas closely imbricate, acute, 2 mm. long, about 0.7 mm. wide, glabrous; palea persistent but the rachilla soon disarticulating, scaberulous on the keel (fig. 17).



FIGURE 17.—*Eragrostis brownei*. From Hitchcock
14519, Hawaii.

⁹ Op. cit., p. 530.

Open places along the trail just below timber line in Hualalai Mts. Prostrate bunches, the culms mostly prostrate; at maturity the flowering culms elongate and become flexuous. Originally described from Australia.

Hawaii: Hualalai Mountains, Hitchcock 14519.

9. *Eragrostis deflexa* sp. nov.

Plants perennial; culms tufted, erect or a little decumbent at base, glabrous, firm, 40 to 100 cm. tall; sheaths glabrous, pilose at the throat and more or less on the collar; blades 10 to 30 cm. long, as much as 4 mm. wide, mostly narrower, flat or involute, tapering to a firm point, glabrous beneath, scabrous on the upper surface and pilose near the base; panicle oblong, erect, 20 to 40 cm. long, 6 to 15 cm. wide, open, the branches in rather distant fascicles, finally spreading or deflexed, scabrous, densely pilose in the lower axils; spikelets somewhat compressed, 4 to 7-flowered, 5 to 8 mm. long, the rachilla flexuous, glabrous, the florets loosely imbricate, disclosing the rachilla, the pedicels somewhat flexuous, the lateral 2 to 4 mm. long; glumes nearly equal, acuminate, 2.5 to 3 mm. long, the slender point of the first usually somewhat longer than the first lemma and narrower than the second glume, scaberulous on the keel; lemmas acute, about 2.5 mm. long and 0.7 mm. wide, rather turgid, the lateral nerves faint, finely scaberulous on the upper part of keel and on the sides near the apex; palea nearly as long as the lemma, finely scaberulous on the keels (fig. 18).

Near *E. lugens* but the panicle longer and more oblong, the branches finally deflexed.

Type in the U. S. National Herbarium, no. 836465, collected in open woods on hillside, Puu Waawaa, Hawaii, Hawaiian islands, August 30, 1916, by A. S. Hitchcock (no. 14476).

Lanai: West side, Hitchcock 14715.

Hawaii: Puu Waawaa, Hitchcock 14476, 14494. South side of island on road to Kilauea, Hitchcock 14593. Hanehane, Kona, Forbes 191.

10. *Eragrostis grandis* Hillebr. Fl. Haw. Isl. 528. 1888.

Plants perennial; culms in large tufts, erect, stout and tall, as much as 1 cm. thick at base and 2 meters tall, glabrous; sheaths glabrous, pilose or glabrous at the throat; ligule a dense row of short hairs with long hairs as much as 7 mm. long intermixed, these deciduous; blades elongate, usually 5 to 10 mm. wide, sometimes narrower, flat, usually involute toward the slender tip, glabrous beneath, scabrous on the upper surface; panicle large and open, oblong, as much as 50 cm. long, the branches in more or less distant fascicles, ascending, mostly spikelet-bearing to near the base, pilose in the axils, the axis smooth below, scabrous above as are the branches; spikelets compressed, 5 to 9 mm. long, 5 to 10-flowered, the rachilla joints about 0.8 mm. long, scabrous, the lateral pedicels short, about 1 mm. long; glumes acuminate, 2.5 to 3 mm. long; lemmas acuminate or acute, 3 mm. long, loosely imbricate, disclosing the rachilla, glabrous, scaberulous on the keel, the lateral nerves faint but made somewhat prominent by the shrinkage of the inter-nerves; palea a little shorter than the lemma, scabrous-ciliate on the keel (fig. 19).

Slopes, ravines, and open forest, mostly in partial shade. Originally described from "High mountains of Molokai! E. and W. Maui!" Two varieties are described, β var. *oligantha* from "Molokai! pali of Waikolu, and (doubtfully) top of Mount Kaala, Oahu!" and γ var. *polyantha* from Molokai.

Kauai: West side Waimea drainage basin, Forbes 1013, 1063. Kaholuamano, 3600 feet, Rock 5129.

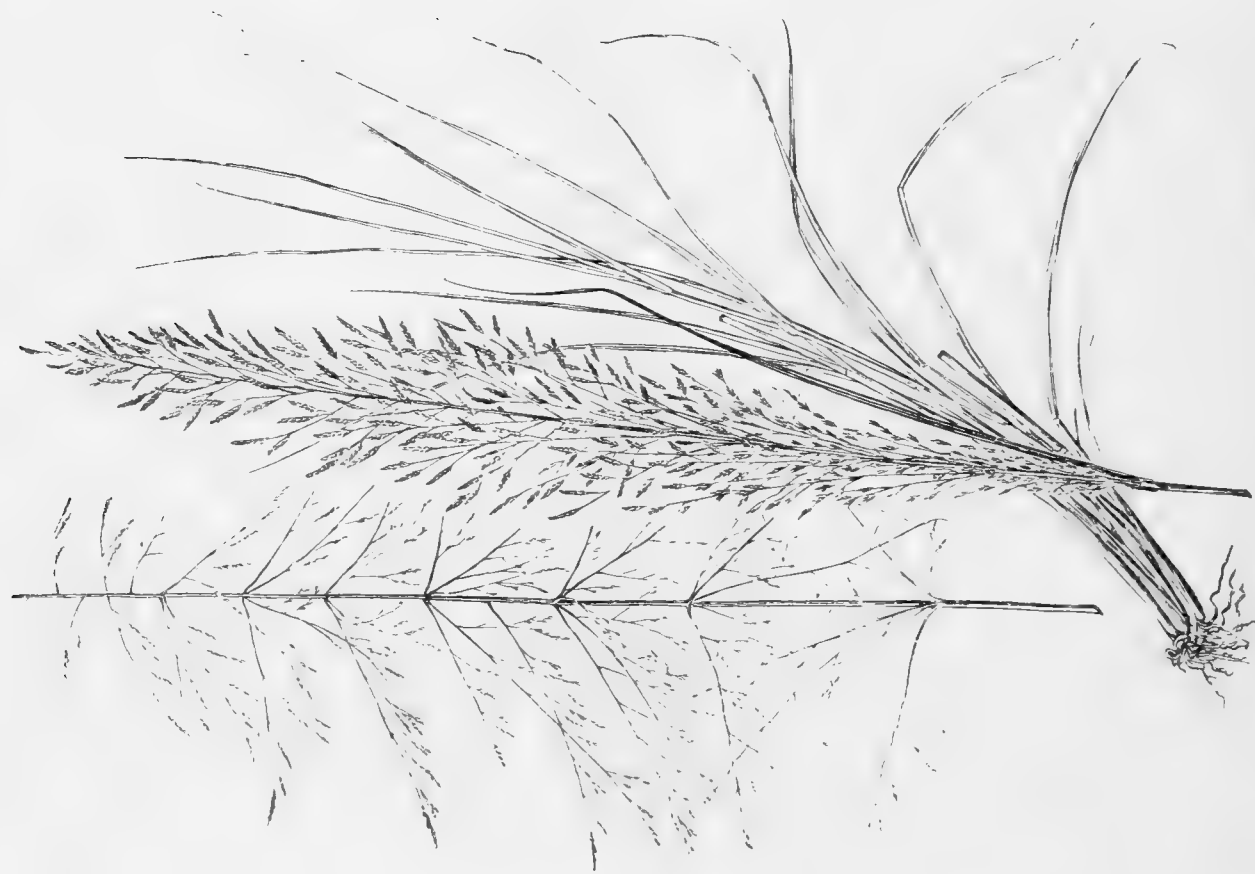


FIGURE 18.—*Eragrostis deflexa*. From the type specimen.



FIGURE 19.—*Eragrostis grandis*. From Hitchcock 14220, Hawaii.

- Oahu: Mountains to west of Schofield Barracks, Hitchcock 13928, 13950, 13951. Makaleha Valley (in Mokuleia), Rock 17087. Without locality, Mann & Brigham 279.
- Molokai: Mountains above Puu Kolekole, Forbes 182. Central part, Hitchcock 15154. Kalae, Rock 16005.
- Lanai: Upper part of mountains, Hitchcock 14692. Ravine at foot of mountains, Hitchcock 14691, 14688. Mountains near Koele, Forbes 70. Without locality, Forbes 320.
- Maui: Near summit of Mt. Eeka, Forbes 367; Rock 16002. Puu Kukui, Hitchcock 14810. Waikapu, Rock. Nahiku, Rock 12733. Haleakala Crater, Hitchcock 14963, 14946. Isthmus, Rock 17072.
- Hawaii: Kukaiau Ranch, Hitchcock 14220. Kohala Mountains, Forbes 487; Rock 4179. Popola, Kau, Forbes 413.
- Without locality: Wilkes Expl. Exped.; Hillebrand; Faurie 1329.

11. *Eragrostis monticola* (Gaud.) Hillebr. Fl. Haw. Isl. 531. 1888.

Poa monticola Gaud. in Freyc. Voy. Uran. Bot. 408. 1830.

Plants perennial; culms in dense tufts, slender, erect or spreading, 10 to 30 cm. tall; sheaths glabrous, pilose at the throat; blades mostly clustered at the base of the plants, 5 to 15 cm. long, 1 to 2 mm. wide but mostly narrowly involute, tapering to a slender point, glabrous beneath, scabrous on the upper surface; panicle erect, narrow and more or less spikelike, often somewhat interrupted, 5 to 15 cm. long, mostly less than 1 cm. wide, the branches short and appressed, the lower 1 to 2 cm. long; spikelets mostly 6 to 8-flowered, about 5 mm. long, the florets scarcely disclosing the glabrous rachilla; glumes acuminate, 2 to 3 mm. long, the first often longer than the first lemma; lemmas about 2 mm. long, rather obtuse, glabrous; palea nearly as long as the glume, scabrous on the keels (fig. 20).

Open dry ground. Originally described from "insulis Sandwicensibus."

Molokai: Central part, Hitchcock 15155. Mapulehu, 3000 feet, Rock 6148. Puu Kolekole, Forbes 217.

Lanai: Open plains, Hitchcock 14693.

Hawaii: District of Puna, Wilkes Expl. Exped. (Gray Herbarium).

Without locality: Hillebrand.

12. *Eragrostis leptophylla* sp. nov.

Plants perennial, with numerous erect innovations; culms densely cespitose, erect, slender, glabrous, mostly about 1 meter tall; sheaths ciliate on the margin, villous at the throat, somewhat pubescent on the collar, otherwise glabrous; ligule a ciliate membrane less than 0.5 mm. long; blades slender, erect, involute, 1 to 2 mm. wide, glabrous on lower surface, villous on upper surface near base, scaberulous near the slender sharp tip; panicle slender, spikelike, mostly rather dense, 15 to 30 cm. long, about 5 to 8 mm. thick, the axis and pedicels scabrous or puberulent; spikelets about 1 cm. long, mostly 8 to 10-flowered, longer than the pedicels; glumes about equal, about 5 mm. long, as long as or longer than the first floret, attenuate-pointed, scaberulous on the keel toward the tip, the first 1-nerved, the second 3-nerved, lemmas acute, rather faintly 3-nerved, about 3 mm. long, faintly scaberulous on the keel toward the tip, imbricate, hiding the rachilla; palea shorter than the lemma, scaberulous on the keels (fig. 21).



FIGURE 20.—*Eragrostis monticola*.
From Hitchcock 15155, Molokai.

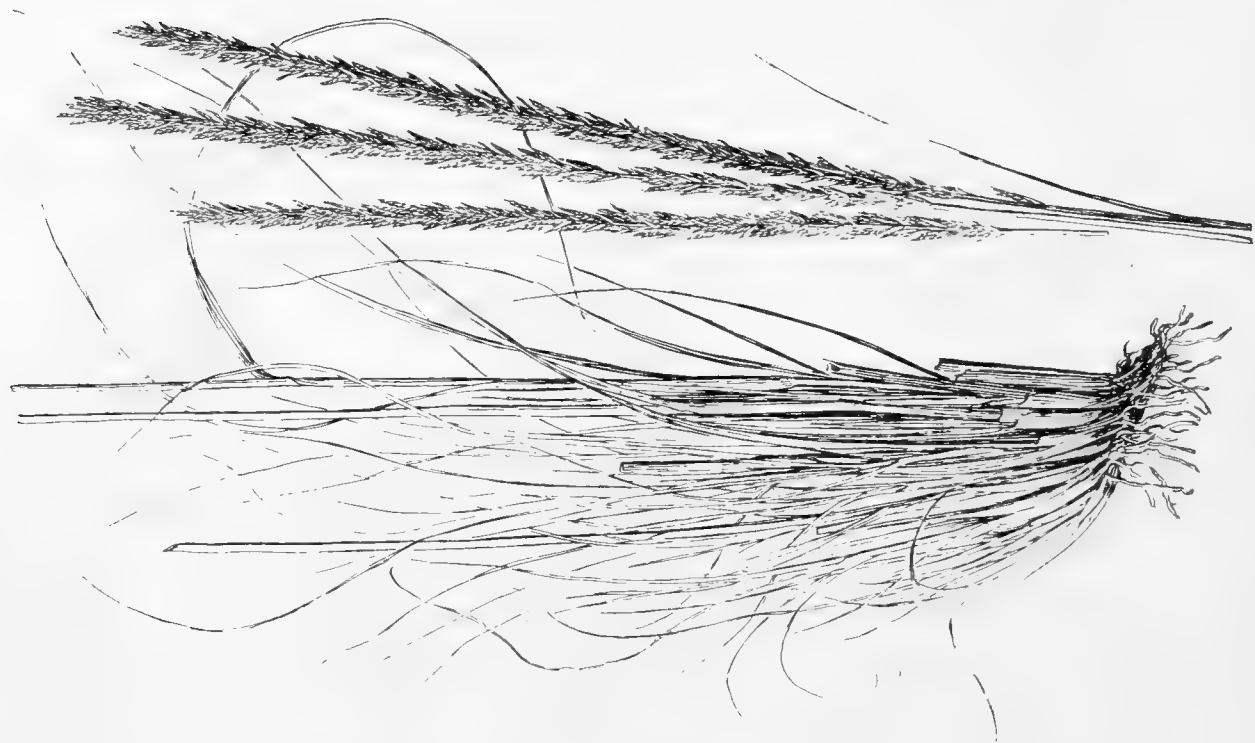


FIGURE 21.—*Eragrostis leptophylla*. From
the type specimen.

Type in the U. S. National Herbarium, no. 836477, collected on the sandy plain west of the Humuula Sheep Station on the flank of Mauna Kea, island of Hawaii, August 29, 1916, by A. S. Hitchcock (no. 14458).

This species is distinguished by the slender, erect culms and blades and the slender, spikelike panicle. It appears to be confined to the western side of Hawaii. Hawaii: West of Humuula Sheep Station, Hitchcock 14440, 14458. Hill south of Humuula Sheep Station, Hitchcock 14447, 14448. Kanehaha, Kona, Forbes 258. Puu Waawaa, Forbes 43. Without locality, Wilkes Expl. Exped.; Remy 92 (Gray Herbarium).

13. *Eragrostis variabilis* (Gaud.) Steud. Nom. Bot. ed. 2. 1:564. 1840, as synonym of *E. wahoensis* Trin.; [as species] Hillebr. Fl. Haw. Isl. 528. 1888.
Poa variabilis Gaud. in Freyc. Voy. Uran. Bot. 408. 1830.
Eragrostis wahoensis Trin. Mém. Acad. St. Pétersb. VI. Math. Phys. Nat. 1:412. 1830.
Eragrostis equitans Trin. Mém. Acad. St. Pétersb. VI. Math. Phys. Nat. 1:413. 1830.
Eragrostis variabilis var. β *ciliata* Hillebr. Fl. Haw. Isl. 529. 1888.
Eragrostis thyrsoides Hillebr. Fl. Haw. Isl. 529. 1888.
Eragrostis hawaiiensis Hillebr. Fl. Haw. Isl. 530. 1888.
Eragrostis phleoides Hillebr. Fl. Haw. Isl. 530. 1888.

Plants perennial, cespitose; culms erect, mostly 40 to 80 cm. tall or taller, glabrous or scaberulous, especially below the panicle; sheaths glabrous, or puberulous at the summit and on the collar, in some plants villous at the throat; ligule a very short ciliate membrane less than 0.5 mm. long; blades mostly flat near the base, involute above and ending in a fine point, as much as 50 cm. long and 1 cm. wide, scabrous-puberulent on the upper surface, in some plants villous near the base, glabrous on the lower surface; panicle narrow, as much as 40 cm. long, somewhat open with ascending branches or dense and spikelike, the main axis scabrous or pubescent, in some plants smooth below, the axils of some pilose; spikelets 5 to 10 mm. long, mostly 8 to 12-flowered, the pedicels smooth or scabrous, the rachilla smooth or puberulous; glumes acuminate or attenuate-pointed, commonly strongly scaberulous on the keels, about equal, 2 to 3 mm. long, the first 1-nerved, the second 3-nerved; lemmas acuminate, 2.5 to 3 mm. long, scabrous on the keel, and even also on the back, especially toward the tip, the 2 lateral nerves often prominent because of the sunken tissue on each side; palea nearly as long as the lemma, scabrous-ciliate on the keels (fig. 22).

A very variable species especially as to the density of the panicle. I have been unable to coördinate the characters so as to segregate distinct species.

Through the courtesy of Dr. Diels, Director of the Botanic Garden at Berlin, I have had the privilege of examining the type specimens of *Eragrostis hawaiiensis*, *E. phleoides*, and *E. thyrsoides*. The three types look rather distinct but they all fall within the range of specimens cited below. The type of *E. phleoides*, from "Haleakala", has a dense spikelike panicle, 5 to 12 cm. long. In *E. thyrsoides* from "Oahu! Maui!" (there are two specimens on the sheet), the panicle is contracted but scarcely spikelike, 20 cm. long on one specimen, lobed or interrupted. The panicle of *E. hawaiiensis*, from "Kohala", is about 35 cm. long, the upper part spikelike, the lower part looser, the branches crowded but ascending, as much as 7 cm. long. The plants of the three specimens are similar, all being rather tall with broad blades mostly convolute above.



FIGURE 22.—*Eragrostis variabilis*. From Hitchcock 15274. Kauai, and (the dense panicle) a specimen named by Hillebrand *E. phleoides*.



FIGURE 23.—*Dactylis glomerata*. From U. S. Dept. Agr. Bull. 772, fig. 28.

Grassy slopes and ridges. Originally described from "insulis Sandwicen-sibus (Alt. 450-500 hexap.)"; *E. wahowensis* described from "Ins. Wahu"; *E. equitans* from "Ins. Wahu."

Kauai: Olokele Gulch, Hitchcock 15274. Haupu Range near Nawiliwili Bay, Forbes 714. West side Waimea drainage basin, Halemanu, Forbes 855, 949; Rock 2180. Kaholuamano, Rock 5131, 12741; Hitchcock 15543; Heller 2830. Cliffs at Haena, Rock 17260. Waimea, Mann & Brigham 251.

Niihau: Kalua Keale (from Forbes) in 1912.

Oahu: Nuuanu Pali, Heller 1992; Hitchcock 13790, 13791; Forbes 1086, 1087. Palolo Valley, Forbes 2403; Hitchcock 14139, 14141, 14142. Kalihi Pali, Forbes 2294. Without locality, Wilkes Expl. Exped.; Mann & Brigham 15, 218; Remy 89 (Gray Herbarium).

Molokai: Mauna Loa, Forbes 16. Kalae, Forbes 47. Kaunakakai Gulch, Forbes 624. East Molokai, Rock 12736. Wailau, Faurie 1332. Ka Lae o ka Laau, Forbes 58.

Maui: Sand hills of Wailuku, Wilkes Expl. Exped. (Gray Herbarium).

Hawaii: Kilauea Crater, Hitchcock 14611. Road to volcano from south, Hitchcock 14591. Mauna Loa, Wilkes Expl. Exped. (Gray Herbarium). Without locality, Mann & Brigham.

Laysan: Fullaway in 1911; Bryan 8730, 8731. Snyder in 1902 (Albatross Haw. Expl.)

Without locality: Hillebrand; Rock 12740.

Arundo donax L. Sp. Pl. 81, 1753, the giant reed, is cultivated for ornament and probably will become established. This is a large herbaceous grass as much as 7 meters tall, with thick knotty rhizomes, flat blades 5 to 7 cm. wide on the main culms, smaller on the branches, and a handsome feathery panicle 30 to 60 cm. long. The conspicuously distichous leaves are distributed rather evenly along the culm.

8. DACTYLIS L.

Spikelets few-flowered, compressed, finally disarticulating between the florets, nearly sessile in dense one-sided fascicles, borne at the ends of the few branches of a panicle; glumes unequal, carinate, acute, hispid-ciliate on the keel; lemmas compressed-keeled, mucronate, 5-nerved, ciliate on the keel. Perennials, with flat blades and fascicled spikelets.

1. *Dactylis glomerata* L. Sp. Pl. 71. 1753. ORCHARD GRASS.

Culms erect, 6 to 120 cm. tall; blades broadly linear; panicle 7 to 15 cm. long, the few stiff branches naked below, contracted after flowering; spikelets crowded in dense 1-sided clusters at the ends of the branches (fig. 23).

Escaped from cultivation in pastures and grassland at upper elevations; introduced. Originally described from Europe.

Kauai: West side Waimea drainage basin, Forbes 1074.

Molokai: Central part, Hitchcock 15159. Papaaloa, Forbes 95.

Hawaii: Paauhau, Rock 3212. Kukaiau Ranch, Hitchcock 14213. Papaaloa, Kona, Forbes 324.



FIGURE 24.—*Hordeum murinum*. From U. S. Dept. Agr. Div. Agrost. Bull. 17, fig. 605.



FIGURE 25.—*Lolium temulentum*. From U. S. Dept. Agr. Div. Agrost. Bull. 17, fig. 587.



FIGURE 26.—*Lolium multiflorum*. From U. S. Dept. Agr. Bull. 772, fig. 52.

Wheat (*Triticum aestivum* L.; *T. vulgare* Vill.; *T. sativum* Lam.) was found as a waif in the experimental fields at Schofield Barracks (Hitchcock 13964, 13965, 13966) and may be found in waste places. Spikelets 2 to 5-flowered, solitary, sessile, placed flatwise at each joint of a continuous rachis, forming a dense spike; glumes rigid, broad, the apex abruptly mucronate or toothed; lemmas keeled, ending in a short point or a long awn; plants annual; a pair of appendages or small auricles at the junction of the sheath and blade.

Rye (*Secale cereale* L.) was also found as a waif at Schofield Barracks (Hitchcock 13962). Plants taller than wheat, the spike nodding; spikelets 2-flowered, solitary and sessile, placed flatwise against the continuous rachis; glumes narrow, rigid, acuminate or subulate-pointed; lemmas broader, sharply keeled, 5-nerved, ciliate on the keel and exposed margins, tapering into a long awn.

9. HORDEUM L.

Spikelets 1-flowered, 3 (sometimes 2) together at each node of the articulate rachis (continuous in *Hordeum vulgare*), the back of the lemma turned from the rachis, the middle one sessile or subsessile, the lateral ones pediceled; rachilla disarticulating above the glumes and, in the central spikelet, prolonged behind the palea as a bristle and in some spikelets bearing a rudimentary floret; lateral spikelets commonly imperfect, in some species reduced to bristles; glumes narrow, often subulate and awned, rigid, standing in front of the spikelet; lemmas rounded on the back, 5-nerved, as a rule obscurely so, tapering into a usually long awn. Annual or perennial low or rather tall grasses, with flat blades and dense terminal spikes.

1. *Hordeum murinum* L. Sp. Pl. 85. 1753. WILD BARLEY.

Plants annual; culms bushy-branched, spreading; sheaths and blades smooth; spike 5 to 7 cm. long, often partially enclosed in the uppermost inflated sheath; glumes of the central spikelet narrowly spindle-form, 3-nerved, long-ciliate on both margins, the nerves scabrous, the awn about 2.5 cm. long; glumes of lateral spikelets unlike, the inner similar to the central, the outer setaceous, not ciliate; lemmas all broad, 8 to 10 mm. long, the awns somewhat exceeding those of the glumes (fig. 24).

Weed in pastures; introduced. Originally described from Europe.

Oahu: Schofield Barracks, Hitchcock 13920.

Hawaii: Makahalau, Rock 3198. Waimea, Hitchcock 14348.

Barley (*Hordeum vulgare* L.) as a waif in the experimental fields was found at Schofield Barracks (Hitchcock 13963). Plants annual with flat blades and dense terminal spikes resembling those of bearded wheat but with longer awns; auricles at base of blade larger than in wheat or rye; spikelets in groups of three, all three fertile in 4 and 6-rowed barley, the kind usually grown; grain (except in naked barley) permanently enclosed in the spikelet.

10. LOLIUM L.

Spikelets several-flowered, solitary and sessile, placed edgewise to the continuous rachis, one edge fitting to the alternate concavities, the rachilla disarticulating above the glumes and between the florets; first glume wanting (except on the terminal spikelet), the second outward, strongly 3 to 5-nerved, equaling or exceeding the second floret; lemmas rounded on the back, 5 to 7-nerved, obtuse, acute, or awned. Annuals or perennials, with flat blades and simple terminal flat spikes.

Plants annual; glume as long as or longer than the spikelet..... 1. **L. temulentum.**
Plants perennial; glume shorter than the spikelet..... 2. **L. multiflorum.**

1. *Lolium temulentum* L. Sp. Pl. 83. 1753.

Plants annual; culms 60 to 80 cm. tall; spike stout and strict, 15 to 20 cm. long; glume about 2.5 cm. long, as long as or longer than the 5 to 7-flowered spikelet, firm, pointed; lemmas as much as 8 mm. long, obtuse, the awn wanting or as much as 8 mm. long (fig. 25).



FIGURE 27.—*Trisetum glomeratum*. From Hitchcock
1484, Hawaii.

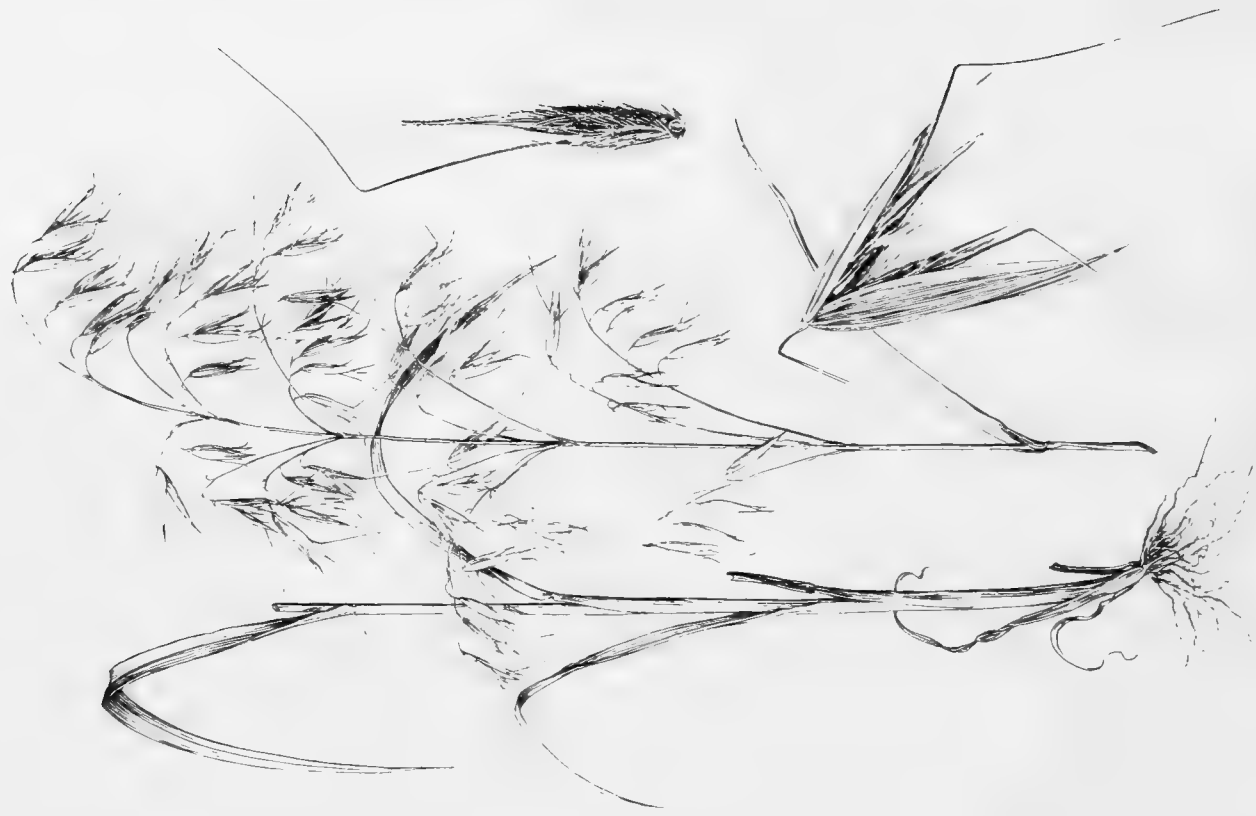


FIGURE 28.—*Avena fatua*. From U. S. Dept.
Agr. Bull. 772, fig. 58.

Weed along road; introduced. Originally described from Europe.
 Oahu: Nuuanu Pali, Hitchcock 13778.
 Hawaii: Hilo, Newell in 1917.

2. **Lolium multiflorum** Lam. Fl. Franç. 3:621. 1778. ITALIAN RYE GRASS.

Short-lived perennials; culms 30 to 60 cm. tall, erect or often decumbent at base, often rough below the spike and on the convex portion of the rachis; spike as much as 30 cm. long; spikelets as much as 2.5 cm. long, twice as long as the glumes, 10 to 20-flowered; lemmas 5 to 6 mm. long, at least the upper awned, the awn as much as 5 mm. long (fig. 26).

Grassland at medium altitudes; introduced. Originally described from Europe.

Oahu: Honolulu, Hitchcock 13859. Schofield Barracks, Hitchcock 13917, 13923.
 Molokai: Papaaloa, Forbes 99. Central part, Hitchcock 15152.
 Hawaii: Paauhau, Rock 3461.

11. **LEPTURUS** R. Br.

Spikelets 1-flowered, embedded in the hard, cylindric, articulate rachis, placed edgewise thereto, the first glume wanting except on the terminal spikelet, the second glume closing the cavity of the rachis and flush with the surface, indurate, nerved, acuminate, longer than the joint of the rachis; lemma lying next the rachis, hyaline, shorter than the glume, 3-nerved; palea hyaline, 2-nerved, a little shorter than the lemma; rachilla not disjoining, the spikelet falling entire, attached to its rachis joint. Low annuals or perennials, with hard cylindric spikes.

1. **Lepturus repens** (Forst.) R. Br. Prodr. Fl. Nov. Holl. 207. 1810.

Rottboellia repens Forst. Prodr. 9. 1786.

Monerma repens Beauv. Ess. Agrost. 117, 168, 177. 1812.

Plants perennial, widely creeping, diffusely branching, the fertile culms ascending or erect, as much as 1 meter tall, commonly shorter; sheaths glabrous; ligule membranaceous, about 1 mm. long, ciliate; blades flat, 10 to 20 or even 30 cm. long, as much as 1 cm. wide, glabrous on the surface, scabrous on the margins, long-acuminate; spikes 5 to 15 cm. long, erect, strict, the margins of the oblong hollows membranaceous, the internodes about 5 mm. long; second glume twice as long as the internode, coriaceous, ovate-lanceolate, acuminate, greenish; lemma about 4 mm. long, pale, oblong-lanceolate, the margins incurved; palea about as long as the lemma.

This has not been observed on the main group of islands but is a common shore grass on the islands to the south and extends to Australia and Ceylon. Originally described from "Insulae intra tropicas," South Pacific.

Midway Island: Bryan in 1902; Bartsch 92.

Palmyra: Rock 10 in 1913.

12. **TRisetum** Pers.

Spikelets usually 2-flowered, sometimes 3 to 5-flowered, the rachilla prolonged behind the upper floret, usually villous; glumes somewhat unequal, acute, awnless, the second usually longer than the first floret; lemmas usually short-bearded at the base, 2-toothed at the apex, the teeth often awned, bearing from the back below the cleft apex a straight and included, or usually bent and exserted, awn. Tufted perennials with flat blades and open or usually contracted or spikelike panicles.

1. **Trisetum glomeratum** (Kunth) Trin.; Steud. Syn. Pl. Glum. 1:229. 1854.

Koeleria glomerata Kunth, Rév. Gram. 2:611. pl. 219. 1834.

Culms densely tufted, erect, glabrous or pubescent, 30 to 100 cm. tall; sheaths usually loose, glabrous or softly pubescent; ligule membranaceous, about 5 mm. long, lacerate at apex; blades rather thick, 10 to 20 cm. long, 2 to 4 or sometimes as much as 6 mm. wide, glabrous or pubescent, flat or more or less involute, especially toward the apex, tapering to a hard subulate point; panicle erect, close and spikelike, more or less interrupted at base, or sometimes interrupted throughout, or even rather loose, 10 to 20 cm. long, usually about 1 cm. thick; spikelets in close clusters, 1 to 3-flowered, compressed; glumes acuminate, about equal in length, about 5 mm. long, scabrous on the keels, scabrous or soft-pubescent on the surface, the first narrow, the second nearly twice as wide as the first; lemmas rather firm, scarcely keeled, obscurely 5-nerved, the lower about 5 mm. long, more or less scabrous, awned on the back below the entire or slightly bifid tip, the awn variable, reduced or wanting, or as much as 2 to 3 mm. long; straight or spreading, commonly shorter on the upper florets, the rachilla joints villous or glabrous (fig. 27).

This species is fairly uniform in habit but varies greatly in the amount of pubescence and in the length of the awns. Plants with 1-flowered spikelets might be referred technically to *Calamagrostis*. The species is intermediate between *Trisetum* and *Koeleria*.

Open ground, sandy or gravelly slopes or plains, 5000 feet and upwards, common near timber line. (Pl. XXXII, A.) Originally described from "Insula Owhyhee, ad montem Kaah," collected by Macrae in 1825. The type is described as being pubescent and as having awns short and erect, or absent from the upper floret.

Lanai: Kalama, Munro 317.

Maui: Haleakala Crater, Faurie 1359, Hitchcock 14959, 14993, 14998, 14953, Rock 8512, 16005. Mountains, East Maui, Wilkes Expl. Exped. (Gray Herbarium).

Hawaii: Hanehane, Kona, Forbes, 168; Mauna Kea, Forbes 853, 854, 855; Hitchcock 14299, 14453, 14457; Rock 8404, 8709, Faurie 1358; region of Sophora, Wilkes Expl. Exped.; Humuula Sheep Station, Hitchcock 14419, 14431; Kukaiau Ranch, Hitchcock 14235, 14244; Aina Hou, Forbes 830; Hualalai Mountains, Rock 3628; Hitchcock 14510, 14520, 14527; Mann & Brigham 326; Luamakani Crater, Rock 3260; Mauna Loa, Hitchcock 14621; north slope Mauna Kea, Hitchcock 14284; Bullock Plains, Wilkes Expl. Exped.; Waimea, Wilkes Expl. Exped. Without locality, Remy 82¹⁰ (Gray Herbarium).

13. *AVENA* L.

Spikelets 2 to several-flowered, the rachilla bearded, disarticulating above the glumes and between the florets; glumes about equal, membranaceous or papery, several-nerved, longer than the lower floret, usually exceeding the upper floret; lemmas indurate, except toward the summit, 5 to 9-nerved, bidentate at the apex, bearing a dorsal bent and twisted awn (this straight and reduced in *Avena sativa*). Annual or perennial, low or moderately tall grasses, with narrow or open commonly few-flowered panicles and large spikelets.

Lemmas glabrous or nearly so..... 1. *A. sativa*.

Lemmas pubescent with long hairs, commonly brown.

Teeth of lemma acute, not awned..... 2. *A. fatua*.

Teeth of lemma awned..... 3. *A. barbata*.

¹⁰ The Remy collection in the Gray Herbarium has two sheets numbered 82. See *Capriola dactylon*.

1. *Avena sativa* L. Sp. Pl. 79. 1753. CULTIVATED OAT.

Similar to *A. fatua*; florets not readily separating from the glumes, spikelets commonly 2-flowered; lemma glabrous; awn straight, or wanting.

Occasional in waste places, mostly as a waif. Originally described from cultivated plants in Europe.

Oahu: Schofield Barracks, Hitchcock 13972.

2. *Avena fatua* L. Sp. Pl. 80. 1753. WILD OAT.

Plants annual; culms 30 to 90 cm. tall, erect, stout; panicle loose and open, the slender branches as a rule horizontally spreading; spikelets commonly 3-flowered; glumes about 2.5 cm. long; rachilla and lower part of shining lemma clothed with long stiff brownish hairs; florets readily falling from the glumes; lemma nerved above, about 2 cm. long, the teeth acuminate but not awned; awn stout, geniculate, red-brown, twisted below, about 3 cm. long (fig. 28).

Weed along roadside; introduced. Originally described from Europe.

Oahu: Nuuanu Pali, Hitchcock 13749.

3. *Avena barbata* Brot. Fl. Lusit. 1:108. 1804.

Differs from *A. fatua* in having somewhat smaller, 2-flowered spikelets, with curved and capillary pedicels; teeth of lemma ending in fine awns 2 mm. long.

Weed along road; introduced. Originally described from Europe.

Oahu: Schofield Barracks, Hitchcock 13934.

14. *ARRHENATHERUM* Beauv.

Spikelets 2-flowered, the lower floret staminate, the upper perfect, the rachilla disarticulating above the glumes, produced beyond the florets as a slender bristle; glumes rather broad and papery, the first 1-nerved, the second a little longer than the first and about as long as the spikelet, 3-nerved; lemmas 5-nerved, hairy on the callus, the lower bearing near the base a twisted, geniculate, exserted awn, the upper bearing a short straight, slender awn just below the tip. Perennial, rather tall grasses, with flat blades and rather dense panicles.

1. *Arrhenatherum elatius* (L.) Beauv.; Mert. & Koch in Röhl, Deutsch. Fl. 1:546. 1823. TALL MEADOW OAT GRASS.

Avena elatior L. Sp. Pl. 79. 1753.

Arrhenatherum avenaceum Beauv. Ess. Agrost. 152, pl. 11, f. 5. 1812.

Culms a meter or more tall; blades as much as 1 cm. wide, scabrous on both surfaces; panicle pale or purplish, shining, 15 to 30 cm. long, narrow, the short branches verticillate, usually spikelet-bearing from the base; spikelets 7 to 8 mm. long; glumes minutely scabrous, the second about equaling the florets; lemmas scabrous, the awn of the staminate floret about twice the length of its lemma; palea as long as the lemma (fig. 29).

Pasture land at medium altitudes. Cultivated as a pasture grass and established here and there. Originally described from Europe.

Hawaii: Kukaiau Ranch, Hitchcock 14267.

15. *AIRA* L.

Spikelets 2-flowered, disarticulating above the glumes, the hairy rachilla prolonged behind the upper floret as a stipe, this in some plants bearing a reduced floret; glumes about equal, acute or acutish, membranaceous; lemmas thin, truncate and 2 to 4-toothed at the summit, bearing a slender awn from or below the middle, the awn straight, bent or twisted. Low or moderately tall annual or commonly perennial grasses, with shining pale or purplish spikelets in narrow or open panicles.



FIGURE 31.—*Calamagrostis hillebrandi*. From Hitchcock 14730, Maui.



FIGURE 30.—*Aira nubigena*. From Hitchcock 14728, Maui.



FIGURE 29.—*Arrhenatherum elatius*. From U. S. Dept. Agr. Bull. 772, fig. 59.

1. *Aira nubigena* (Hillebr.).

Aira australis Nees; Steud. Syn. Pl. Glum. 1:220. 1854. Not *Aira australis* Raoul, 1846.

Deschampsia australis Nees; Hillebr. Fl. Haw. Isl. 520. 1888.

Deschampsia pallens Hillebr. Fl. Haw. Isl. 520. 1888. Not *Aira pallens* Spreng. 1807.

Deschampsia nubigena Hillebr. Fl. Haw. Isl. 521. 1888.

Plants perennial, often in dense tufts; culms 30 to 100 cm. tall, stiff, glabrous; sheaths glabrous; ligule firm, 3 to 4 mm. long; blades firm or coriaceous, folded or involute, glabrous or scabrous, 0.5 to 1.5 mm. wide as folded, sometimes in a short basal cluster 5 to 10 cm. long, sometimes elongate; panicle ovate to oblong, 5 to 30 cm. long, open or somewhat contracted, usually bronze-tinted, the capillary branches in fascicles, some naked at base, some spikelet-bearing near the base; spikelets shining; glumes acuminate, nearly equal, about 5 mm. long, mostly bronzed in the middle, hyaline at margin and yellowish at the tip, scabrous on the keels; lemmas glabrous, about 4 mm. long, the callus hairs about 1 mm. long; awn from near the base, variable in length, nearly straight and included, or bent and exerted as much as 5 mm. (fig. 30).

The three species given by Hillebrand (*Deschampsia pallens*, *D. australis*, *D. nubigena*) seem to be all forms of *A. nubigena*. It grows on the dry plains of the upper elevations in company with *Trisetum glomeratum*. It also grows in the open bogs at the summits of the mountains, where it is often more dwarfed with short basal tufts of leaves, and in the wet forest where the whole plant is more lax.

Dry slopes and plains and also swamps, at upper altitudes. *Aira australis* was described from "Ins. Owyhee"; *Deschampsia nubigena* was described from "top of Mt. Eēka, Maui."

Kauai: Kaholuamano, Rock 4176; Hitchcock 15340. Alakai Swamp, Forbes 875.

Waialeale, Hitchcock 15506. Waimea, 2000 to 3000 feet, Mann & Brigham 306.

Molokai: Wailau, Faurie 1284. Kamalo Bog, Hitchcock 15104.

Maui: Puu Kukui, Hitchcock 14728, 14825; Rock 8139. "Mt. Eēke" Forbes 368.

Olinda, wet forest, Hitchcock 14899, 14907. Haleakala Crater, Rock 8511; Hitchcock 14942, 14965, 14969; Forbes 294.

Hawaii: Mauna Loa near Rest House, Hitchcock 14622; at 8000 feet, Wilkes Expl. Exped. Kilauea, Faurie 1363. Hualalai Mountains, Hitchcock 14521; Forbes 199. Hanehane, Kona, Forbes 170. Holualoa, Forbes 805. Luamakani, Rock 3114, 3219. Kukaiau Ranch, Hitchcock 14225, 14250. Hilo, Rainbow Falls, Hitchcock 14198; Newell in 1917. Waikii, Rock 8408. Humuula Sheep Station, Hitchcock 14437; Forbes 852. Mauna Kea, Faurie 1366.

Without locality: Wilkes Expl. Exped.; Hillebrand.

16. *ASPRIS* Adans.

Spikelets 2-flowered, the rachilla disarticulating above the glumes, not prolonged; glumes about equal, acute, membranaceous or subscarios; lemmas firm, rounded on the back, tapering into two slender teeth, the callus with a very short tuft of hairs, bearing on the back below the middle a slender, geniculate, twisted awn commonly exerted. Low, delicate annuals (apparently perennial in the Hawaiian islands) having small open or contracted panicles.

1. *Aspris caryophyllea* (L.) Nash in Britt. & Brown, Illustr. Fl. ed. 2. 1:214. 1913.

Aira caryophyllea L. Sp. Pl. 66. 1753.

Culms solitary or few or in the Hawaiian plant, numerous in apparently perennial tufts, with a dense basal tuft of leaves, erect, 10 to 30 cm. tall; blades short, setaceous; panicle open,



FIGURE 32.—*Notholcus lanatus*. From U.
S. Dept. Agr. Bull. 772, fig. 62.



FIGURE 33.—*Aspris caryophyllea*. From U.
S. Dept. Agr. Bull. 772, fig. 61.

the silvery shining spikelets 3 mm. long, clustered toward the ends of the spreading capillary branches; lemma of both florets with a geniculate awn 4 mm. long, the teeth setaceous (fig. 33).

A weed along trail, 4000 to 6000 feet; introduced. Originally described from Europe.

Maui: Haleakala Crater, Hitchcock 14973. Along Olinda pipe line in very wet forest, Hitchcock 14938.

17. **NOTHOLCUS** Nash.

Spikelets 2-flowered, the pedicel disarticulating below the glumes, the rachilla curved and somewhat elongate below the first floret, not prolonged above the second floret; glumes about equal, longer than the two florets; first floret perfect, its lemma awnless; second floret staminate, its lemma awned on the back. Perennial grasses, with flat blades and contracted panicles.

1. **Notholcus lanatus** (L.) Nash; Hitchc. in Jepson, Fl. Calif. 1:126. 1912. VELVET GRASS.

Holcus lanatus L. Sp. Pl. 1048. 1753.

Plants grayish, velvety-pubescent; culms erect, 30 to 60 cm. tall; panicle 5 to 10 cm. long, narrow, contracted, sometimes almost spikelike, purple-tinged; spikelets 4 mm. long; glumes villous, hirsute on the nerves, the second broader than the first, 3-nerved; lemmas ciliate at the apex; awn of the second floret hooklike (fig. 32).

Pasture land at medium altitudes; introduced. Originally described from Europe.

Hawaii: Kukaiau Ranch, Hitchcock 14204, 14252. Paauhau, Rock 3437.

18. **CALAMAGROSTIS** Adans.

Spikelets 1-flowered, the rachilla disarticulating above the glumes, generally prolonged behind the palea as a short, commonly hairy bristle; glumes about equal, acute or acuminate; lemma shorter and as a rule more delicate than the glumes, the callus bearing a tuft of hairs, these in many species copious and as long as the lemma, awned from the back, usually below the middle, the awn being delicate and straight, or stouter and exserted, bent and sometimes twisted; palea shorter than the lemma. Perennial, usually moderately tall or robust grasses, with small spikelets in open or usually narrow, sometimes spikelike panicles.

Callus hairs very short..... 1. **C. hillebrandi**.

Callus hairs longer than the floret..... 2. **C. expansa**.

1. **Calamagrostis hillebrandi** (Munro).

Deyeuxia hillebrandi Munro; Hillebr. Fl. Haw. Isl. 519. 1888.

Culms tufted, apparently with slender rhizomes, erect, glabrous, 30 to 50 cm. tall; sheaths glabrous, longer than the internodes; ligule a membrane about 1 mm. long, erose; blades flat or more or less involute, those of the midculm 10 to 15 cm. long, 2 to 4 mm. wide when flat, the uppermost near the panicle, 2 to 4 cm. long, all very scabrous on the upper surface, glabrous or nearly so beneath, firm and stiff; panicle ovate, 5 to 10 cm. long, 3 to 7 cm. wide, rather loose, the branches ascending, glabrous, commonly pubescent about the base, the lower in fascicles, naked below, branching below the middle; glumes nearly equal, acuminate, 4 to 6 mm. long, glabrous including the keel; lemma 4 to 5 mm. long, firm, faintly 5-nerved, short-pilose at base, the hyaline apex 4-toothed, the teeth extending into slender awns as much as 1 mm. long; awn dorsal, arising above the middle, scabrous, curved-spreading, 5 to 10 mm. long; palea nearly as long as the lemma, sharply 2-toothed, scaberulous on the keels; rachilla prolongation more than half as long as the lemma, silky-villous, the hairs extending as far as the tip of the lemma (fig. 31).



FIGURE 34.—*Calamagrostis expansa*. From Hitchcock 14830, Maui.



FIGURE 35.—*Agrostis retrofracta*. From Hitchcock 14531, Hawaii.

Open bogs, summit of mountains. Originally described from "top of Mt. Eēka, Maui."

Molokai: Central part, Hitchcock 15186.

Maui: Puu Kukui, Hitchcock 14730; Rock 8190, 16003; "Mt. Eēka", Forbes 369.

2. *Calamagrostis expansa* (Munro).

Deyeuxia expansa Munro; Hillebr. Fl. Haw. Isl. 519. 1888.

Culms 50 to 60 cm. tall, erect, decumbent and naked below; sheaths minutely retorse-scaberulous, overlapping rather closely along the middle of the culm; ligule membranaceous, 1 to 2 mm. long; blades flat or more or less involute, firm, 15 to 20 cm. long, as much as 1 cm. wide, the uppermost near the panicle, 2 to 4 cm. long, ending in a hard sharp point, glabrous beneath, scabrous on the upper surface; panicle oblong, contracted, 8 to 15 cm. long, the axis and branches scabrous; glumes acuminate, about 7 mm. long, the keels scabrous; lemma thin, 3 to 4 mm. long, 4-toothed at apex, the teeth slender, the callus hairs abundant and a little longer than the lemma; awn from near the middle, scabrous, spreading, about 5 mm. long; palea a little shorter than the lemma, 2-toothed, scabrous on the keels; rachilla prolongation about 0.5 to 2 mm. long with silky hairs similar to the callus hairs (fig. 34).

The lemma is glabrous in Hitchcock's no. 14830 and scabrous in Forbes's no. 371. Hillebrand, who had only a fragment, states that the lemma is glabrous. The duplicate type in the Gray Herbarium is larger than the specimens cited below. The panicle is 20 cm. long, and the blades as much as 1.5 cm. wide.

Boggy places at upper altitudes. Originally described from "north bank of the crater of Haleakala (U. S. E. Exp.)."

Maui: Edge of woods near bog, summit of Puu Kukui, Hitchcock 14830, "Mt. Eēka", Forbes 371. North bank of crater, East Maui, Wilkes Expl. Exped. (Gray Herbarium).

19. AGROSTIS L.

Spikelets 1-flowered, disarticulating above the glumes, the rachilla in most species not prolonged; glumes equal or nearly so, acute, acuminate, or even awn-pointed, carinate, usually scabrous on the keel and in some species also on the back; lemma obtuse, usually shorter and thinner in texture than the glumes, awnless or dorsally awned, often hairy on the callus; palea usually shorter than the lemma, 2-nerved in only a few species, in most species small and nerveless or obsolete. Annual or usually perennial, delicate or moderately tall grasses, with glabrous culms, mostly flat scabrous blades, and open or contracted panicles of small spikelets.

Lemma pubescent; panicle finally diffuse..... 1. *A. retrofracta*.
Lemma glabrous; panicle more or less open but not diffuse.

Spikelets awnless; plants spreading or decumbent.

Panicle contracted and lobed or verticillate; glumes scabrous on keel and back..... 2. *A. verticillata*.

Panicle more open; glumes scabrous on keel, smooth on back..... 3. *A. stolonifera*.
Spikelets awned (some awnless in *A. sandwicensis*).

Panicle small but open..... 4. *A. canina*.

Panicle contracted and spikelike.

Plants solitary or few together in bogs..... 5. *A. fallax*.

Plants strongly tufted.

Blades involute..... 6. *A. sandwicensis*.

Blades flat..... 7. *A. exarata microphylla*.

1. *Agrostis retrofracta* Willd. Enum. Pl. 94. 1809.

Avena filiformis Forst. Prodr. 9. 1786. Not *Agrostis filiformis* Vill. 1787.

Deyeuxia retrofracta Kunth, Rév. Gram. 1:77. 1829.

Deyeuxia forsteri Kunth, Rév. Gram. 1:77. 1829.

Calamagrostis retrofracta Link; Steud. Nom. Bot. ed. 2. 1:251. 1840.

Plants tufted, soft and lax; culms erect or decumbent at base, 20 to 60 cm. tall; sheaths glabrous or scabrous; ligule conspicuous, membranaceous, as much as 8 mm. long; blades flat, 10 to 20 cm. long, 0.5 to 3 mm. wide, scabrous on the upper surface, glabrous beneath; panicle 10 to 30 cm. long, becoming very diffuse, with long capillary, fascicled, scabrous branches, spikelet-bearing toward the ends; spikelets pale; glumes 2 to 3 mm. long, acuminate, scabrous on the keel; lemmas 1.5 mm. long, silky pubescent, obtuse, dentate; awn from about the middle, 3 mm. long; prolongation of rachilla about 0.3 mm. long, the silky hairs extending to 1 mm. (fig. 35).

This species is intermediate between *Agrostis* and *Calamagrostis*. The habit is that of the former genus, the silky prolongation of the rachilla is that of *Calamagrostis*.

Wet cliffs and grassy slopes up to 8000 feet. Originally described from Australia.

Kauai: Olokele Gulch, Hitchcock 15199, 15223, 15253. Kaholuamano, Heller 2779.

Oahu: Schofield Barracks, Hitchcock 13947, 13959. Palehua, Waianae Range,

Forbes 1692. Mt. Tantalus, Hitchcock 13870.

Molokai: Kamalo, Hitchcock 15103.

Lanai: Upper part of mountain, Hitchcock 14640.



FIGURE 36.—*Agrostis verticillata*. From U. S. Dept. Agr. Div. Agrost. Bull. 17, fig. 484.



FIGURE 37.—*Agrostis fallax*. From Hitchcock 14729, Maui.

Maui: Lahaina, Hitchcock 14885. Puu Kukui, Hitchcock 14764. West Maui, Rock.

Hawaii: Summit of Hualalai Mountains, Hitchcock 14531. Hilo, Hitchcock 14195. Kukaiau Ranch, Hitchcock 14205, 14232. Paauhau, Rock 3462, 5124. Waimea, Hitchcock 14376.

Without locality: Hillebrand.

2. *Agrostis verticillata* Vill. Prosp. 16. 1779.

Agrostis kauaiensis Hillebr. Fl. Haw. Isl. 516. 1888.

Culms commonly decumbent at base, sometimes with long creeping and rooting stolons, the flowering branches 20 to 40 cm. tall; blades flat, mostly less than 10 cm. long, 2 to 4 mm. wide, scabrous; panicle contracted, lobed or verticillate, especially at base, 3 to 10 cm. long, light green, the branches flower-bearing from the base; glumes equal, obtuse or barely acute, scabrous on back and keel, 2 mm. long; lemma half as long as glumes, awnless, truncate and toothed at apex; palea nearly as long as the lemma (fig. 36).

Moist places, banks of streams; introduced. Originally described from Europe. *Agrostis kauaiensis* was described from "Kauai! Waimea (Kn., and M. & B. no. 273)." These specimens probably came from the same general region as the Kauai specimens listed below.

Kauai: Kaholuamano, Hitchcock 15301. Waimea drainage basin, Kokee stream, Forbes 774. Waimea, 2000 to 3000 feet, Mann & Brigham 273 (type collection of *A. kauaiensis*). Without locality, Rock 5120.

Hawaii: Kukaiau Ranch, Hitchcock 14221. Puu Waawaa, Hitchcock 14474.

3. *Agrostis stolonifera* L. Sp. Pl. 62. 1753. REDTOP.

Culms decumbent at base, with long creeping stolons, 30 to 60 cm. tall; sheaths smooth; ligule membranaceous, 2 to 4 mm. long; blades flat, scabrous, 10 to 15 cm. long, 3 to 4 mm. wide; panicle ovate or oblong, 10 to 20 cm. long, moderately contracted or somewhat open; glumes acuminate, about 2.5 mm. long, scabrous on the keel, glabrous on the back; lemma a little shorter than the glumes, awnless; palea about half as long as the lemma.

Pasture land in the mountains; introduced. Originally described from Europe.

Kauai: Waimea drainage basin, Waimeke paddock, Forbes 1018.

Oahu: Mt. Tantalus, Hitchcock 13869.

Molokai: Poholua, Forbes 98.

Hawaii: Kukaiau Ranch, Hitchcock 14216, 14231.

4. *Agrostis canina* L. Sp. Pl. 62. 1753.

Culms erect or, in the Hawaiian specimens, often creeping at base, 10 to 30 cm. tall; leaves in a firm basal tuft, and a few on the culm, less than 5 cm. long, the basal ones capillary; panicle oblong, open, but the branches ascending or appressed; glumes 2 mm. long or a little shorter, acuminate; lemma a little shorter than the glumes, the awn from about the middle, longer than the glumes, bent (fig. 38).

Grassland; introduced. Originally described from Europe.

Hawaii: Glenwood, Rock 12738, July 1912.

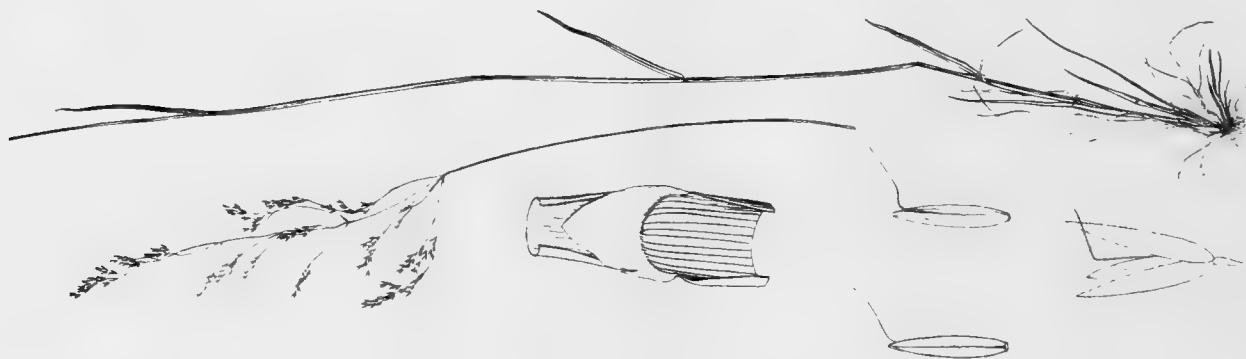


FIGURE 38.—*Agrostis canina*.
From U. S. Dept. Agr. Bur.
Pl. Ind. Bull. 68, pl. 9, fig. 2.



FIGURE 39.—*Agrostis sandwicensis*. From Hitchcock
14631, Hawaii.



FIGURE 40.—*Agrostis exarata*
microphylla. From U. S. Dept.
Agr. Bur. Pl. Ind. 68, pl. 19,
fig. 1.

5. *Agrostis fallax* Hillebr. Fl. Haw. Isl. 516. 1888.

Culms solitary or few together, with creeping rhizomes, erect, 15 to 30 cm. tall; sheaths glabrous; ligule membranaceous, 3 mm. long; blades of innovations capillary, of the culm 1 to 2 mm. wide, all less than 10 cm. long; panicle narrow, spikelike, 5 to 10 cm. long; glumes broad at base, acute, 4 mm. long, scabrous on the keel; lemma rather broad, about 2 mm. long, obtuse, the summit divided into 4 fine short teeth, the awn from below the middle, nearly straight or somewhat bent, 3 mm. long, extending about to the tip of the glumes or a little beyond; palea none (fig. 37).

Open bogs on summit of mountain. Originally described from "Plateau of Mt. Eeka, Maui!"

Maui: Puu Kukui, Hitchcock 14729. Mt. Eeka, in summit swamp, 5000 feet, Rock 16001.

6. *Agrostis sandwicensis* Hillebr. Fl. Haw. Isl. 515. 1888.

Agrostis rockii Hack. Repert. Nov. Sp. Fedde, 10:167. 1911.

Plants densely tufted, the culms and blades generally stiffly upright; culms 30 to 50 cm. tall, scabrous; sheaths scabrous; ligule acute, 3 mm. long; blades firm, scabrous, involute or sometimes flat, 1 to 2 mm. wide when flat, sharp-pointed; panicle spikelike, 5 to 10 cm. long, the branches and pedicels very scabrous; glumes narrow, acuminate, 3 to 4 mm. long, scabrous on keel and back; lemma thin, 2 mm. long, the faint nerves extending into minute teeth, the awn from about the middle, bent and twisted below, about as long as the glumes, or reduced, or almost wanting; palea wanting (fig. 39).

Sandy or gravelly plains and slopes at upper altitudes, mostly from 8000 to 11000 feet. Originally described from "E. Maui! Oahu!"

Maui: Haleakala Crater, Hitchcock 14976; Rock 8508 (type collection of *A. rockii*), 16004.

Hawaii: Kau Desert, Rock 12580. Hualalai Mountains, Hitchcock 14529. Mauna Kea, Hitchcock 14285, 14298, 14452; Forbes 474. Bullock Plains, Wilkes Expl. Exped. Kukaiau Ranch, Hitchcock 14243. Kilauea Crater, Hitchcock 14604. Mauna Loa, Hitchcock 14631. Na Puu o Pele, Wilkes Expl. Exped. Road from Kona to Volcano, Hitchcock 14592. Humuula Sheep Station, Hitchcock 14418. Without locality, Mann & Brigham; Remy 75 (Gray Herbarium).

7. *Agrostis exarata microphylla* (Steud.) Hitchc. Amer. Journ. Bot. 2:303. 1915.

Agrostis microphylla Steud. Syn. Pl. Glum. 1:164. 1854.

Culms tufted, 60 cm. tall, scabrous below the panicle; sheaths scabrous; ligule 3 mm. long; blades flat, rather lax, scabrous, 10 to 15 cm. long, 2 to 4 mm. wide; panicle contracted, interrupted, 10 to 20 cm. long, branches and pedicels scabrous; spikelets in clusters, short-pedicel, pale; glumes acute or acuminate, about 3 mm. long, scabrous on the keel and more or less on the back; lemma thin, 1.5 mm. long, the awn from near the middle, twisted below, geniculate or straight, extending about 2 mm. beyond the glumes; palea none (fig. 40).

Moist places; introduced. Originally described from western North America.

Hawaii: Kukaiau Ranch, 6000 feet, in a gulch, Hitchcock 14245.

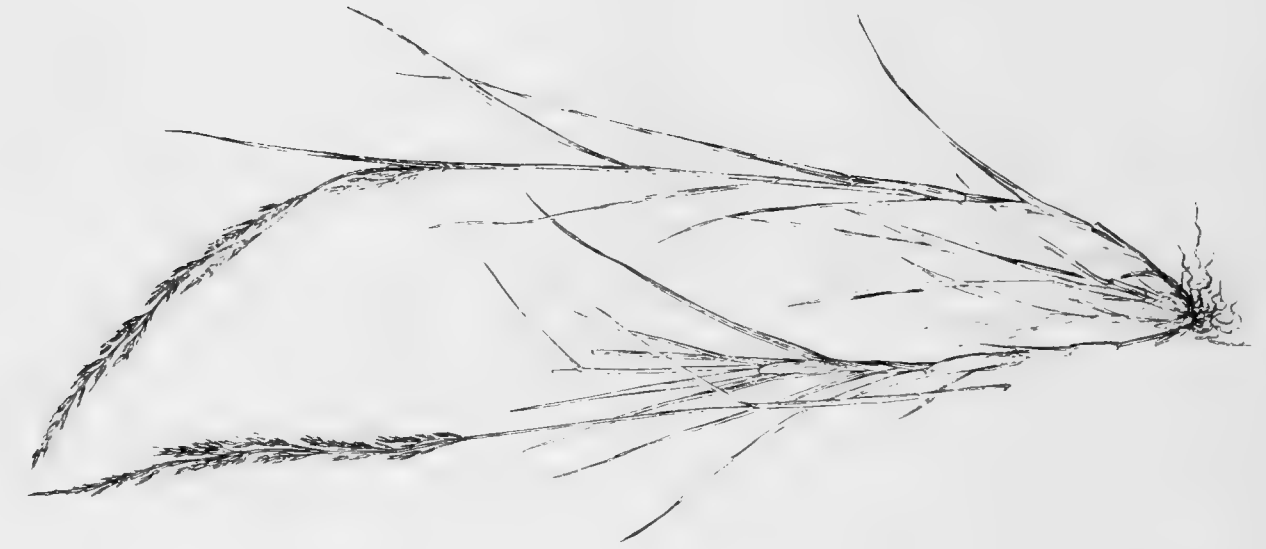


FIGURE 41.—*Garnotia sandwicensis*.
From Hitchcock 14193, Hawaii.



FIGURE 42.—*Polypogon monspeliensis*. From U. S. Dept. Agr.
Bull. 772, fig. 75.



FIGURE 43.—*Gastridium ventricosum*.
From U. S. Dept. Agr. Bull. 772,
fig. 78.

20. **GARNOTIA** Brongn.

Spikelets 1-flowered, the pedicel disarticulating below the glumes, in unequally pediceled pairs, scarcely compressed; glumes narrow, about equal, rather rigid, often awned, the first 1-nerved, the second 3-nerved; lemma usually awned at the apex; palea as long as the body of the lemma. Annual or perennial grasses with flat blades and narrow panicles.

1. **Garnotia sandwicensis** Hillebr. Fl. Haw. Isl. 513. 1888.

Plants perennial, tufted; culms erect or decumbent, glabrous, 30 to 50 cm. tall; sheaths glabrous, villous on the margin and somewhat so at the throat and on the collar; ligule a short ciliolate membrane less than 1 mm. long; blades flat but more or less involute toward the end in drying, glabrous beneath, slightly scabrous on the upper surface, 5 to 15 cm. long, less than 5 mm. wide, narrowed at the base, long-acuminate at the apex; panicle narrow, rather closely flowered, 7 to 15 cm. long, the branches appressed; spikelets nearly terete, in pairs appressed along the branches, the shorter pedicel 1 to 2 mm. long, the other twice as long, both angled and scabrous, thickened upward, the base of the spikelet stiffly pilose with hairs about 0.5 mm. long; glumes firm, about 4 mm. long, scaberulous on the nerves and somewhat so on the back, 3-nerved, the first with an awn about 5 mm. long, the second depressed or flat on the back, the awn about 2 mm. long; lemma firm, glabrous, rounded on the back, somewhat depressed, very faintly nerved, a little shorter than the glumes, sparsely pilose near margins at base, extending into a scabrous awn about 1 cm. long; palea about as long as the lemma, bearing a minute tuft of hairs at apex (fig. 41).

This species is closely allied to *G. stricta* Brongn.¹¹ originally described from Tahiti and extending to the Philippines. In the latter species the hairs at the base of the spikelet are shorter and fewer, the glumes are acuminate or the first slightly awned. The awns are directly from the tips of the glumes while in *G. sandwicensis* there is a slight notch or shoulder at the tip of the glume.

Moist cliffs or slopes. Originally described from "Molokai on grassy slopes of the northern shore (Waikolu)," and a variety with shorter awns from Hawaii. Molokai: Mapulehu Valley, near Pukoo, Forbes 306. Without locality, Hillebrand. Maui: Nahiku, East Maui, Forbes 253.

Hawaii: Hilo, Faurie 1340; Rainbow Falls, Hilo, Hitchcock 14193; Newell in 1917. Na Puu o Pele, Wilkes Expl. Exped.

21. **POLYPOGON** Desf.

Spikelets 1-flowered, the pedicel disarticulating a short distance below the glumes, leaving a short-pointed callus attached; glumes equal, entire or 2-lobed, awned from the tip or from between the lobes, the awn slender, straight; lemma much shorter than the glumes, hyaline, usually bearing a slender straight awn shorter than the awns of the glumes. Annual or perennial, usually decumbent grasses, with flat blades and dense, bristly, spikelike panicles.

Plants annual; panicle compact, very silky; awns 7 to 10 mm. long..... 1. **P. monspeliensis**.
Plants perennial; panicle somewhat lobed; awns 2 to 3 mm. long..... 2. **P. lutosus**.

1. **Polypogon monspeliensis** (L.) Desf. Fl. Atlant. 1:67. 1798.

Alopecurus monspeliensis L. Sp. Pl. 61. 1753.

Plants annual; culms erect or decumbent at base, scabrous below the panicle, depauperate or as much as 80 cm. tall; sheaths smooth; ligule large; panicle dense and spikelike, 2 to 15 cm. long, 1 to 2.5 cm. thick, green or tawny; glumes hispidulous, 2 mm. long, bearing a slender awn 7 to 10 mm. long from a minutely 2-lobed apex; lemma smooth and shining, 1 mm. long, minutely toothed at the truncate apex, and bearing an awn about 1 mm. long (fig. 42).

¹¹ Duperrey, L. I., Voyage de la Coquille: Botanique, Vol. 2, p. 133, pl. 21, 1830.

A weed in moist places along roads in the mountains; introduced. Originally described from Europe.

Oahu: Nuuanu Pali, Hitchcock 13751. Honolulu, Newell in 1917.

Hawaii: Kilauea Crater, Hitchcock 14605. Alakalei Gorge, Rock 4189.

2. **Polypogon lutosus** (Poir.) Hitchc. U. S. Dept. Agr. Bull. 772:138. 1920.

Agrostis littoralis With. Arr. Brit. Pl. ed. 3. 2:129. 1796. Not *Agrostis littoralis* Lam. 1791.

Polypogon littoralis Smith, Comp. Fl. Brit. 13. 1800.

Agrostis lutosus Poir. in Lam. Encycl. Suppl. 1:249. 1810.

Plants perennial; culms geniculate at base, 30 to 70 cm. tall; sheaths scabrous; ligule 2 to 4 mm. long, or the uppermost longer; panicles oblong, 5 to 15 cm. long, more or less interrupted or lobed; glumes equal, scabrous on back and keel, 2 to 3 mm. long, acute, with a terminal awn as long as the body or longer; lemma as in *P. monspeliensis* (fig. 44).

Moist rocks and banks of streams; introduced. Originally described from Europe.

Oahu: Nuuanu Pali, Hitchcock 13789. Honolulu, Heller 2210.

Maui: Haleakala, above Ukulele, Forbes 171. Lahaina, Hitchcock 14871.

Hawaii: Kanehaha, Kona, Forbes 261.

Without locality: Hillebrand.



FIGURE 44.—*Polypogon lutosus*. From U. S. Dept. Agr. Div. Agrost. Bull. 17, fig. 472.

22. **GASTRIDIDIUM** Beauv.

Spikelets 1-flowered, the rachilla disarticulating above the glumes, prolonged behind the palea as a minute bristle; glumes unequal, somewhat enlarged or swollen at the base; lemma much shorter than the glumes, hyaline, broad, truncate, awned or awnless; palea about as long as the lemma. Annual grasses, with flat blades and pale, shining, spikelike panicles.

1. **Gastridium ventricosum** (Gouan) Schinz & Thell. Mitt. Bot. Mus. Univ. Zurich 58:39. 1913.

Agrostis ventricosa Gouan, Hort. Monsp. 39. pl. 1. f. 2. 1762.

Milium lendigerum L. Sp. Pl. ed. 2. 91. 1762.

Gastridium australe Beauv. Ess. Agrost. 164. 1812.

Gastridium lendigerum Desv. Obs. Angers 48. 1818.

Culms about 30 cm. tall, smooth; panicle 5 to 8 cm. long, dense and spikelike; spikelets 5 to 6 mm. long, the glumes subulate-acuminate, the second shorter; lemma much shorter than the glumes, subglobose, pubescent at apex, the awn 5 mm. long (fig. 43).

A weed in pastures; introduced. Originally described from Europe.

Oahu: Schofield Barracks, Hitchcock 14048.

Maui: Haleakala, Rock 8558; collector unknown [Faurie?] 1356.

23. **SPOROBOLUS** R. Br.

Spikelets 1-flowered, the rachilla disarticulating above the glumes; glumes awnless, usually unequal, the second often as long as the spikelet; lemma membranaceous, 1-nerved, awnless; palea usually prominent and as long as the lemma or longer; seed free from the pericarp. Annual or perennial grasses, with small spikelets in open or contracted panicles.

Plants with strong creeping rhizomes..... 1. **S. virginicus**.
Plants tufted, without rhizomes.

Inflorescence spikelike..... 2. **S. elongatus**.

Inflorescence narrow but not spikelike..... 3. **S. diander**.

1. **Sporobolus virginicus** (L.) Kunth, Rév. Gram. 1:67. 1829.

Agrostis virginica L. Sp. Pl. 63. 1753.

Plants perennial, with strong scaly creeping rhizomes; culms 10 to 30 cm. tall, glabrous, pilose at the throat but the hairs sometimes deciduous; sheaths glabrous, mostly overlapping, the blades conspicuously distichous, ascending or spreading, mostly 2 to 4 cm. long, sometimes longer, 2 to 3 mm. wide, flat or involute, firm, glabrous beneath, sometimes pilose on the upper surface; panicle spikelike, tapering above and often also below, 2 to 5 cm. long; spikelets 2 to 2.5 mm. long, pale; glumes unequal, scarcely nerved, acute, the first about two-thirds as long as the floret, the second as long as the floret; lemma and palea acutish, the lemma smooth, faintly keeled and scarcely nerved (fig. 45).

Sandy beaches, tropics of both hemispheres. Originally described from Virginia.

Oahu: Kahuku, Hitchcock 13884. Without locality, Mann & Brigham 245.

Molokai: West end, Hitchcock 15130.

Maui: Sand hills, Wilkes Expl. Exped.

Without locality: Hillebrand; "Insulis Sandwich", Faurie 1320.

2. **Sporobolus elongatus** R. Br. Prodr. Fl. Nov. Holl. 170. 1810.

Plants perennial, tufted; culms erect, glabrous, somewhat compressed, 50 to 80 cm. tall; sheaths glabrous, sparingly pilose at the throat, shorter than the internodes, exposing one, 2, or rarely 3, nodes of the culm; blades flat or usually involute, the lower elongate, 2 to 4 mm. wide, ending in a fine point, glabrous beneath; panicle spikelike, 10 to 20 cm. long, 5 mm.



FIGURE 45.—*Sporobolus virginicus*. From U. S.
Dept. Agr. Div. Agrost. Bull. 17, fig. 470.



FIGURE 46.—*Sporobolus elongatus*. From Hitchcock 13949, Oahu.

thick, mostly plumbeous, interrupted below, the lower branches appressed, somewhat distant, 1 to 2 cm. long, the upper part dense; lateral panicles produced in the axils of the leaves; spikelets about 2 mm. long; glumes unequal, the first one-fourth as long as the floret, obtuse or truncate, broad, the second about half as long as the floret, acute; lemma and palea equal, nerveless; caryopsis red-brown, oblong, 1.2 mm. long (fig. 46).

This species is allied to *S. berterianus* of the West Indies. The habit is somewhat different, because of the flattened falcate internodes and the narrow and denser panicles. As in that species the reddish fruits at maturity remain attached to the panicle by their mucilaginous coating. Our species is rarely attacked by the black fungus which gives to the allied *S. berterianus* its name of smut grass.

Grassy slopes and savannas; apparently introduced but abundant in places. Originally described from Australia.

Oahu: Schofield Barracks, Hitchcock 13940, 13949.

Molokai: Central part, Hitchcock 15162.

Maui: Olinda, East Maui, Hitchcock 14934. Haleakala above Ukulele, East Maui, Forbes 170.

Hawaii: Kukaiau Ranch, Hitchcock 14203. Kukuihaele, Rock 4508.

3. *Sporobolus diander* (Retz.) Beauv. Ess. Agrost. 26, 147. 1812.

Agrostis diandra Retz. Obs. Bot. 5:19. 1789.

Plants perennial; culms tufted, erect from a geniculate base, slender, glabrous, 30 to 60 cm. tall; sheaths glabrous, sometimes sparsely pilose at the throat; blades flat, 1 to 2 mm. wide; panicle narrow, but loose, as much as 30 cm. long, the branches ascending or somewhat spreading, the lower 2 to 3 cm. long, the spikelets short-pedicel and clustered along these main branches; spikelets 1.5 mm. long, scarcely compressed, glabrous; glumes unequal, obtuse, or the second acutish, the first about one-fourth as long as the floret, the second about one-half as long; lemma and palea equal, obtuse or acutish; caryopsis brown, about 0.8 mm. long (fig. 47).

Allied to *S. indicus* of South America, the panicle looser and more delicate.

Grassland along streets; introduced. Originally described from India.

Oahu: Honolulu, Hitchcock 14070; Forbes 1715.

Osterdamia matrella (L.) Kuntze. Rev. Gen. Pl. 2:781. 1891. (*Agrostis matrella* L. Mant. Pl. 2:185. 1771) has been introduced as a lawn grass and was collected at Wailuku, Maui, by Faurie (no. 1329). This is a creeping grass with strong rhizomes, the flowering culms spreading or prostrate, 10 to 15 cm. long, with short distichous blades, and a narrow rather few-flowered panicle, the sessile spikelets about 3 mm. long, these disarticulating from the pedicel, the first glume wanting, the second glume infolding the thin lemma and palea. Originally described from India.

Leptochloa virgata (L.) Beauv. Ess. Agrost. 166. 1812. (*Cynosurus virgatus* L. Syst. Nat. ed. 10. 2:87. 1759.) This was growing in Mr. Von Tempsky's garden on the Haleakala Ranch, Maui, under the name of Judd grass. An erect smooth perennial with several slender spikes along the upper part of the culm.

24. *ELEUSINE* Gaertn.

Spikelets few to several-flowered, compressed, sessile and closely imbricate, in two rows along one side of a rather broad rachis, the latter not prolonged beyond the spikelets; rachilla disarticulating above the glumes and between the florets, glumes unequal, rather broad, acute, 1-nerved, shorter than the first lemma; lemmas acute with 3 strong green nerves close together forming a keel, the uppermost somewhat reduced; seed dark brown, roughened by fine ridges,



FIGURE 47.—*Sporobolus diander*. From Hitchcock 14070, Oahu.



FIGURE 48.—*Eleusine indica*. From U. S. Dept. Agr. Bull. 772, fig. 103.

loosely inclosed in the thin pericarp. Annual grasses with two to several rather stout spikes, digitate at the summit of the culms, some plants with one or two spikes a short distance below, or rarely with a single terminal spike (fig. 48).

1. **Eleusine indica** (L.) Gaertn. Fruct. & Sem. 1:8. 1788. GOOSE GRASS.

Cynosurus indicus L. Sp. Pl. 72. 1753.

Plants very smooth; culms flattened, decumbent at base or prostrate-spreading; sheaths loose, overlapping, compressed; spikes 2 to 10, 3 to 7 cm. long; spikelets appressed, 3 to 5-flowered, about 5 mm. long (fig. 48).

Weed along streets; introduced. Originally described from India.

Kauai: Lihue, Forbes 735.

Oahu: Honolulu, Hitchcock 13710. Waikiki, Heller 2290.

Hawaii: Hilo, Newell in 1917. Without locality, Wilkes Expl. Exped.

25. **DACTYLOCTENIUM** Willd.

Spikelets 3 to 5-flowered, compressed, sessile and closely imbricate, in two rows along one side of the rather narrow flat rachis, the end projecting in a point beyond the spikelets; rachilla disarticulating above the first glume and between the florets; glumes somewhat unequal, broad, 1-nerved, the first persistent upon the rachis, the second mucronate or short-awned below the tip, deciduous; lemmas firm, broad, keeled, acuminate or short-awned, 3-nerved, the lateral nerves indistinct, the upper floret reduced; palea about as long as the lemma; seed subglobose, ridged or wrinkled, inclosed in a thin, early-disappearing pericarp. Annual or perennial grasses, with flat blades and two to several short thick spikes, digitate and widely spreading at the summit of the culms.

1. **Dactyloctenium aegyptium** (L.) Richt. Pl. Eur. 1:68. 1890.

Cynosurus aegyptius L. Sp. Pl. 72. 1753.

Culms ascending or prostrate, 10 to 30 cm. long; blades flat, mostly less than 10 cm. long and 4 mm. wide, more or less ciliate at base; spikes 2 to 5, 1 to 3 cm. long, rather thick, densely flowered; spikelets pectinate, 3 mm. long; palea winged on the keels (fig. 49).

A weed along streets; introduced. Originally described from "Africa, Asia, America."

Oahu: Honolulu, Hitchcock 13682. Diamond Head, Forbes 1074.

26. **CAPRIOLA** Adans.

Spikelets 1-flowered, awnless, sessile in two rows along one side of a slender continuous rachis, the rachilla disarticulating above the glumes and prolonged behind the palea as a slender naked bristle, this sometimes bearing a rudimentary lemma; glumes narrow, acuminate, 1-nerved, about equal, shorter than the floret; lemma strongly compressed, pubescent on the keel, firm in texture, 3-nerved, the lateral nerves close to the margins. Perennial, usually low, grasses, with creeping stolons or rhizomes, short blades, and several slender spikes digitate at the summit of the upright flowering culms.

1. **Capriola dactylon** (L.) Kuntze, Rev. Gen. Pl. 2:764. 1891. BERMUDA GRASS.

Panicum dactylon L. Sp. Pl. 58. 1753.

Cynodon dactylon Pers. Syn. Pl. 1:85. 1805.

Culms flattened, wiry, glabrous; ligule a conspicuous ring of white hairs; spikes 4 or 5, 3 to 6 cm. long; spikelets imbricate, 2 mm. long, the lemma longer than the glumes (fig. 50).



FIGURE 49.—*Dactyloctenium aegyptium*. From
U. S. Dept. Agr. Bull. 772, fig. 104.



FIGURE 50.—*Capriola dactylon*. From U. S. Dept. Agr. Bull. 772, fig. 105.

Open grassland at low altitudes, a weed along streets and in lawns and gardens; introduced. Originally described from southern Europe. Native name manienie.

Kauai: Lihue, Forbes 465.

Oahu: Honolulu, Hitchcock 13708; Didrichsen 3444. Hauula, Farmer 12. Wai-kiki, Heller 1960. Without locality, Remy 82 (Gray Herbarium).

Hawaii: Hilo, Newell in 1917.

Without locality: Hillebrand.

27. *CHLORIS* Swartz.

Spikelets with 1 perfect floret, sessile, in two rows along one side of a continuous rachis, the rachilla disarticulating above the glumes, produced beyond the perfect floret and bearing 1 to several reduced florets consisting of empty lemmas, in some species truncate, and, if more than one, the smaller ones inclosed in the lower, forming generally a club-shaped rudiment; glumes somewhat unequal, the first shorter, narrow, acute; lemma keeled, usually broad, 1 to 5-nerved, often villous on the callus and villous or long-ciliate on the keel or marginal nerves, awned from between the short teeth of a bifid apex, the awn slender or sometimes reduced to a mucro, the sterile lemmas awned or awnless. Perennial or sometimes annual, tufted grasses, with flat blades and few to several often showy and feathery spikes aggregate at the summit of the culms.

Plants annual

Rudiment broad and truncate..... 1. *C. paraguayensis*.

Rudiment narrow, acute..... 2. *C. radiata*.

Plants perennial.

Awn less than 2 mm. long; plants abundantly stoloniferous..... 3. *C. gayana*.

Awn more than 5 mm. long; plants not stoloniferous..... 4. *C. truncata*.

1. *Chloris paraguayensis* Steud. Syn. Pl. Glum. 1:204. 1854.

Andropogon barbatus L. Mant. Pl. 2:302. 1771. Not *Andropogon barbatus* L. Syst. Nat. ed. 10. 2:305. 1759, which is *Chloris polydactyla* Swartz.

Chloris barbata Swartz, Fl. Ind. Occ. 1:200. 1797.

Plants annual; culms 30 to 60 cm. tall, glabrous; sheaths glabrous, shorter than the internodes; blades flat, mostly less than 10 cm. long; spikes few to several, 2 to 5 cm. long, erect or ascending, often a little flexuous, purplish; spikelets closely imbricate; glumes narrow, acute, the first 1.5 mm., the second 2 mm. long; fertile lemma broad, obovate, rounded at the summit, 2 mm. long, a little pilose along the keel, the callus appressed-pilose, the marginal nerves long-silky on the upper half, the slender awn about 1 cm. long; palea of fertile lemma as long and nearly as broad as the lemma, the keels marginal; rudiment about 1 mm. long, of two triangular-truncate thin sterile lemmas, one within the other on a slender stipe, lifted to about the height of the fertile lemma, the awns about 5 mm. long (fig. 51).

A weed along streets; introduced. Originally described from Paraguay.
Oahu: Honolulu, Hitchcock 13711, 14066; Faurie 1282; Newell in 1917.

2. *Chloris radiata* (L.) Swartz, Prodr. Veg. Ind. Occ. 26. 1788.

Agrostis radiata L. Syst. Nat. ed. 10. 2:873. 1759.

Plants annual; culms decumbent at base, 30 to 60 cm. long; sheaths glabrous, compressed; blades flat or folded, 5 to 15 cm. long, 2 to 4 mm. wide, scabrous; spikes ascending, slender, numerous, 4 to 8 cm. long, pubescent at the base, the rachis puberulent; glumes narrow, awn-pointed, the second 2.5 mm. long; fertile lemma firm, compressed, narrow, acute, 3 mm. long, short-pilose at base, the margins incurved, the marginal nerves short-pilose toward the tip, the awn delicate, 5 to 10 mm. long; sterile lemma narrow, acute, inclosed by the fertile lemma, the awn 3 to 5 mm. long (fig. 52).



FIGURE 51.—*Chloris paraguayensis*. From Rose,
Fitch & Russell 3534. St. Croix, W. Ind.



FIGURE 52.—*Chloris radiata*. From Sintenis 28, Porto Rico.

A weed along streets; introduced. Originally described from Jamaica.

Kauai: Olokele Gulch, Hitchcock 15250.

Oahu: Honolulu, Hitchcock 13681, 14121. Waikiki, Heller 1963. Without locality, Remy 76 (Gray Herbarium).

Lanai: Mr. Gay's place, Hitchcock 14722.

Hawaii: Halawa, Faurie 1283.

Without locality: Hillebrand.

3. *Chloris gayana* Kunth, Rév. Gram. 1:89. 1829. RHODES GRASS.

Plants perennial, producing strong creeping stolons; culms stout, 60 to 120 cm. tall, compressed; blades elongate, scabrous, as much as 7 mm. wide; spikes ascending, rather thick, several to many, 6 to 9 cm. long; glumes unequal, rather broad, the first acute, 1.5 mm. long, the second mucronate, 2 mm. long; fertile lemma oblong, acute, 3 mm. long, the marginal nerves short-pilose below, longer-pilose above, the awn below the tip, about 2 mm. long; first sterile lemma oblong, similar in shape to the fertile lemma, 2.5 mm. long, glabrous, the awn about 1.5 mm. long, the palea as long as the lemma; second sterile lemma an oblong truncate rudiment about 1 mm. long on a slender stipe, awnless (fig. 53).

Introduced as a meadow grass and cultivated in the drier parts. Tending to become established. Originally described from Africa.

Oahu: Schofield Barracks, open grassland, becoming well established, Hitchcock 13946. Honolulu, Kalihi Valley, Hitchcock 14088.

Lanai: Upper part of mountain, Hitchcock 14641.

Maui: Without locality, Curran 18.

Hawaii: Puu Waawaa, hay field on Mr. Hind's ranch, Hitchcock 14492. Pasture on north side of Mauna Kea, Hitchcock 14296.

4. *Chloris truncata* R. Br. Prodr. Fl. Nov. Holl. 186. 1810.

Plants perennial; culms tufted, erect, or decumbent at base, 10 to 30 cm. tall; sheaths compressed; blades flat or folded, short, 1 to 2 mm. wide; spikes several in 1 or 2 whorls, finally spreading, slender, 5 to 10 cm. long, pubescent at base; spikelets 3 mm. long, narrowly wedge-shaped, appressed along the rachis; first glume narrow, acuminate, a little over 1 mm. long; second glume nearly as long as spikelet, apiculate, hyaline; fertile lemma black, oblong-cuneate, truncate at apex, short-pilose at base and appressed-ciliolate on the marginal nerves above, the awn about 1 cm. long; rudiment black, truncate-cuneate, about half as long as the spikelet and raised on a stipe of about its own length (fig. 54).

Open grassland; introduced. Originally described from Australia.

Oahu: Fort Shafter, Honolulu, Hitchcock 13849.

Also grown at United States Agricultural Experiment Station, Westgate, Oct. 9, 1915.

28. *BOUTELOUA* Lag.

Spikelets 1-flowered, with the rudiments of one or more florets above, sessile, in two rows along one side of the rachis; glumes unequal, 1-nerved, acuminate or awn-tipped, the first shorter and narrower; lemma as long as the second glume or a little longer, 3-nerved, the nerves extending into awns, the internerves usually extending into teeth; palea 2-nerved, sometimes 2-awned; rudiment various, commonly 3-awned, a second rudimentary floret present, in some species. Perennial or a few species annual, low or rather tall grasses, with two to several or many spikes racemose on a common axis, or in some species solitary, the spikelets few



FIGURE 53.—*Chloris gayana*. From Hitchcock 13667, Arizona.

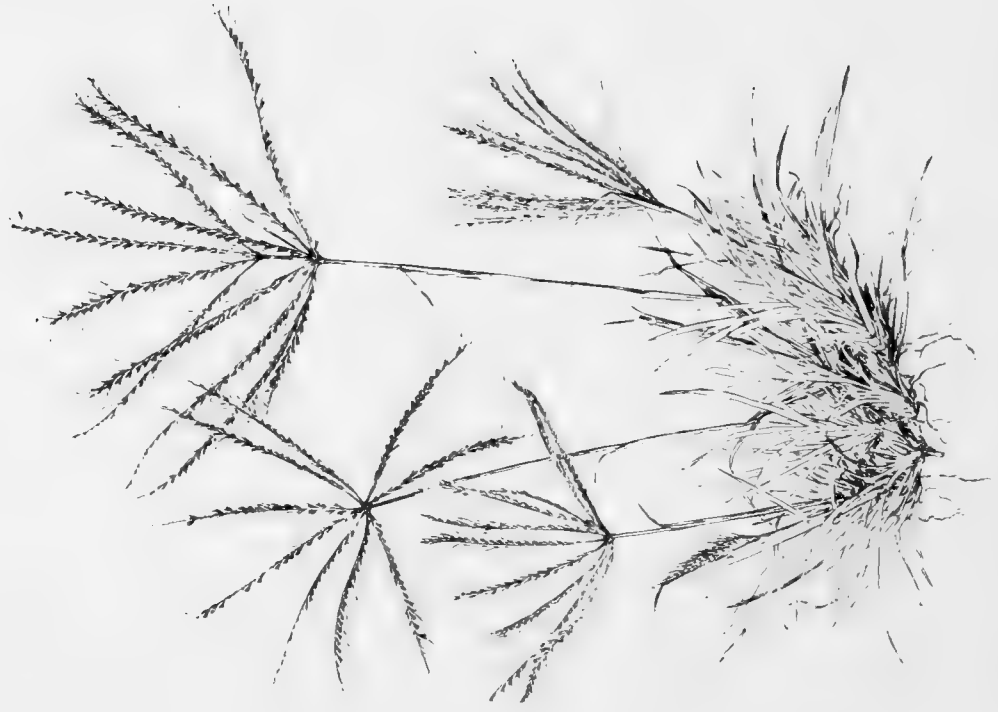


FIGURE 54.—*Chloris truncata*. From Hitchcock 13849, Oahu.

to many in each spike, pectinate or more loosely arranged and appressed, the rachis of the spike usually produced beyond the insertion of the spikelets.

1. **Bouteloua curtispindula** (Michx.) Torr. in Emory, Notes Mil. Recon. 154. 1848.

Chloris curtispindula Michx. Fl. Bor. Amer. 59. 1803.

Plants perennial, tufted; culms erect, slender, 30 to 60 cm. tall; blades elongate, 2 to 3 mm. wide, scabrous; inflorescence a 1-sided raceme 10 to 20 cm. long of short deflexed spikes; spikes 8 to 10 mm. long, with few spikelets; lemma scabrous, ending in 3 short slender awns; sterile lemma with 2 acute lobes and 3 straight awns, the lateral ones much shorter than the middle awn (fig. 55).

On United States Agricultural Experiment Station grounds (substation) halfway up Mt. Tantalus. Introduced but apparently established away from original planting. Originally described from Illinois.

Oahu: Hitchcock 14075, 14064.

29. **MICROLAENA** R. Br.

Spikelets with 1 perfect terminal floret and 2 sterile lemmas below, disarticulating above the minute glumes; sterile lemmas narrow, firm, awned from the tip; fertile lemma hyaline, compressed, shorter than the sterile lemmas; palea narrow, compressed, nerveless, shorter than the lemma; lodicules 2, large, hyaline, broad. Perennial, rather low or lax grasses, with mostly flat rather short blades and narrow loose panicles, the spikelets short-pedicel and appressed along the axis or the main branches.

1. **Microlaena stipoides** (Labill.) R. Br. Prodr. Fl. Nov. Holl. 210. 1810.

Ehrhartia stipoides Labill. Nov. Holl. Pl. 1:91. pl. 118. 1804.

Culms more or less decumbent at base, glabrous; sheaths glabrous or retrorsely scabrous, shorter than the internodes; ligule a very short membrane; blades flat, spreading, mostly less than 10 cm. long, 2 to 3 mm. wide, scabrous on the margins and upper surface; panicle narrow, about 10 cm. long, mostly simple, the rather distant spikelets appressed along the slender main axis, a few short branches below with 2 or 3 spikelets; spikelets narrow, about 1 cm. long, the pedicels 1 to 2 mm. long, the rachilla somewhat elongate above the glumes and between the sterile lemmas; glumes very short, nerveless, unequal, less than 1 mm. long; sterile lemmas rather firm, narrow, 5-nerved, scaberulous on the keels, the rather prominent callus pilose with appressed hairs about 1 mm. long, the apex narrowed into a slender awn 1 to 1.5 cm. long, the first shorter; fertile lemma compressed, faintly 7-nerved, about as long as the sterile lemma and inclosed in its margins, scabrous on the keel, apiculate; palea similar to the lemma, a little shorter, nerveless; lodicules 2, prominent, broad and hyaline, irregularly triangular, about 1 mm. long; stamens 4; stigmas long and plumose (fig. 56).

Open dry forest. Originally described from Tasmania. Also in Australia, New Zealand, and the Philippines.

Hawaii: Puu Waawaa on summit of hill, Hitchcock 14465.

30. **ANTHOXANTHUM** L.

Spikelets with 1 terminal perfect floret and 2 sterile lemmas, the rachilla disarticulating above the glumes, the sterile lemmas falling attached to the fertile floret; glumes unequal, acute or mucronate; sterile lemmas shorter than the glumes, empty, awned from the back; fertile lemma shorter than the sterile ones, awnless; palea 1-nerved, rounded on the back, inclosed in the lemma. Sweet-smelling annual or perennial grasses, with flat blades and spike-like panicles.

1. **Anthoxanthum odoratum** L. Sp. Pl. 28. 1753. SWEET VERNAL GRASS.

Plants perennial; culms slender, erect, 20 to 60 cm. tall; panicle 3 to 8 cm. long, pointed; spikelets brownish green, 8 to 10 mm. long; glumes sparsely pilose; first sterile lemma short-



FIGURE 58.—*Phalaris californica*. Adapted from U. S. Dept. Agr. Div. Agrost. Bull. 7, fig. 79.



FIGURE 57.—*Anthoxanthum odoratum*. From U. S. Dept. Agr. Bull. 772, fig. 120.



FIGURE 56.—*Microlaena stipoides*. From Hitchcock 14465, Hawaii.



FIGURE 55.—*Bouteloua curtipendula*. From U. S. Dept. Agr. Bull. 772, fig. 115.

awned below the apex, the second bearing a strong, bent, scarcely exerted, awn near its base (fig. 57).

Pastures at medium altitudes; introduced. Originally described from Europe.

Molokai: Central part, Hitchcock 15170. Papaaloa, Forbes 96.

Hawaii: Kukaiau Ranch, Hitchcock 14212.

31. PHALARIS L.

Spikelets laterally compressed, with 1 terminal perfect floret and 2 sterile lemmas below, disarticulating above the glumes, arranged in usually dense spikelike panicles; glumes equal, boat-shaped, often winged on the keel; sterile lemmas reduced to 2 small scales (rarely only 1); fertile lemma coriaceous, shorter than the glumes, inclosing the faintly 2-nerved palea. Annual or perennial erect grasses, with flat blades.

Plants perennial; about 1 meter tall..... 1. **P. californica.**

Plants annual, mostly less than 50 cm. tall.

Spikelets in groups of 7, 1 fertile surrounded by 6 sterile..... 2. **P. paradoxa.**

Spikelets single, all alike..... 3. **P. minor.**

1. *Phalaris californica* Hook & Arn. Bot. Beechey Voy. 161. 1841.

Plants perennial; culms erect or somewhat geniculate at base, about 1 meter tall; blades flat, rather lax, 6 to 12 mm. wide; panicle ovoid or oblong, 3 to 5 cm. long, 1.5 to 2.5 cm. thick, often purplish tinged; glumes about 6 to 7 mm. long, narrow, gradually narrowed from below the middle to an acute apex, smooth or slightly scabrous on the keel, the lateral nerves somewhat nearer the margin than the keel; fertile lemma ovate-lanceolate, about 4 mm. long, rather sparsely villous, often exposing the palea, the sterile lemmas about 1 mm. long (fig. 58).

Wet places; probably introduced. Originally described from California.
Maui: Haleakala, east part of crater, Hitchcock 14999.

2. *Phalaris paradoxa* L. Sp. Pl. ed. 2. 2:1665. 1763.

Plants annual; culms cespitose, more or less spreading at base, 30 to 50 cm. tall; panicle dense, oblong, narrowed at base, 2 to 5 cm. long, often inclosed in the uppermost enlarged sheath; spikelets finally falling from the axis in groups of 7, the central fertile, nearly sessile, the others sterile, slender-pedicled; glumes of sterile spikelets narrow, with faint lateral nerves, the keel prominently winged above, the wing extending into a more or less well-marked tooth, the apex of the glume narrowed into an acuminate point or awn, the glumes of the 4 outer sterile spikelets in the lower part of the panicle more or less deformed; glumes of the fertile central spikelet lanceolate, 6 to 8 mm. long including the awn, the lateral nerves prominent, the wing on the keel wider and toothed near summit, the apex of the glume narrowed into an awn about 2 mm. long; fertile lemma smooth and shining, 3 mm. long, the sterile lemmas obsolete.

Weed along road; introduced. Originally described from Europe.
Oahu: Nuuanu Pali, Hitchcock 13780.

3. *Phalaris minor* Retz. Obs. Bot. 3:8. 1783.

Plants annual; culms erect, 30 to 50 cm. tall; panicle ovate-oblong, 1.5 to 5 cm. long; glumes oblong, 4 to 6 mm. long, strongly winged on the keel, the green stripes on the glumes rather prominent, the wing scabrous on the margin and more or less toothed; fertile lemma ovate, acute, villous, about 3 mm. long, the sterile lemma solitary, about 1 mm. long.

Weed in field; introduced. Originally described from Europe.

Oahu: Schofield Barracks, Hitchcock 13915.

Maui: Haleakala, Hitchcock 14988.

Rice (*Oryza sativa* L. Sp. Pl. 333. 1753) is cultivated and is occasionally found growing spontaneously in fields and ditches.

Arundinella agrostoides Trin. is included doubtfully by Hillebrand¹² but should be omitted as the locality "Oahu" is probably an error.

32. VALOTA Adans.

Spikelets lanceolate, in pairs, short-pediceled, in two rows along one side of a narrow rachis; first glume minute, glabrous; second glume and sterile lemma about as long as the fruit, 3 to 5 nerved, copiously silky; fertile lemma cartilaginous, lanceolate, acuminate, usually brown, the flat white hyaline margins broad. Perennial grasses, the slender racemes erect or nearly so, aggregate along the upper part of the main axis, forming a pale or brownish woolly panicle.

1. *Valota insularis* (L.) Chase, Proc. Biol. Soc. Washington 19:188. 1906. SOUR GRASS.

Andropogon insularis L. Syst. Nat. ed. 10. 2:1304. 1759.

Panicum leucophaeum H. B. K. Nov. Gen. & Sp. 1:97. 1816.

Culms erect, or decumbent at base, about 1 meter tall, glabrous; sheaths sparsely hirsute or glabrous; blades flat, elongate, 5 to 10 mm. wide; panicle 15 to 20 cm. long, nodding, the numerous racemes about 10 cm. long; spikelets narrow, about 4 mm. long, appressed along the rachis; second glume and sterile lemma obscured by the long silky tawny hairs; fruit acuminate, 3 mm. long (fig. 60).

Along roadsides and in waste places, infrequent; introduced. Originally described from Jamaica.

Oahu: Honolulu, Hitchcock 13841.

33. SYNTHESISMA Walt.

(Digitaria Hall.)

Spikelets solitary or in twos or threes, subsessile or short-pediceled, alternate in two rows on one side of a three-angled winged or wingless rachis; spikelets lanceolate or elliptic, plano-convex; first glume minute or wanting; second glume equaling the sterile lemma or shorter; fertile lemma cartilaginous, the hyaline margins pale. Annual or sometimes perennial, erect or prostrate grasses, the slender racemes digitate or somewhat scattered, but aggregate at the summit of the culms. Our species are all annuals.

Spikelets 1.5 mm. long, obtuse.

Stems creeping, the sterile shoots with short broad blades 1 to 2 cm. long. 1. *S. longiflora*.

Stems erect, or decumbent at base; blades all linear..... 2. *S. chinensis*.

Spikelets 3 mm. long, acute.

Racemes several, erect, remaining close together even at maturity..... 3. *S. pruriens*

Racemes ascending or spreading at maturity.

First glume evident, 0.5 mm. long; second glume about two-thirds as long as the spikelet, villous on the margins..... 4. *S. sanguinalis*.

First glume wanting or only about 0.2 mm. long; second glume usually not over half as long as the spikelet.

Second glume acute, about half as long as the spikelet, slightly villous; racemes 2 to 4..... 5. *S. debilis*.

Second glume obtuse, less than one-fourth as long as the spikelet; racemes several..... 6. *S. microbachne*.

¹² Op. cit., p. 514.

1. *Syntherisma longiflora* (Retz.) Skeels, U. S. Dept. Agr. Bur. Pl. Ind. Bull. 261:30. 1912.

Paspalum longiflorum Retz. Obs. Bot. 4:15. 1786.

Stems creeping, as much as 40 cm. long, sending up flowering culms 10 to 20 cm. tall, erect from an ascending base, glabrous, sparingly pilose at the nodes; sheaths glabrous, shorter than the internodes; ligule membranaceous, about 1 mm. long; blades ovate-lanceolate to oblong-lanceolate, 1 to 2 cm. long, 3 to 5 mm. wide, clasping at the sparsely pilose base, glabrous; racemes 2 or 3, digitate, slender, often curved, 2 to 4 cm. long, the rachis narrowly winged, glabrous; spikelets 1.5 mm. long, elliptic, acute, nearly glabrous, the longer pedicel terete, glabrous, about 1 mm. long; first glume wanting; second glume as long as the spikelet, 3-nerved; sterile lemma as long as the spikelet, 5-nerved; fruit pale, acute, as long as the spikelet (fig. 59).

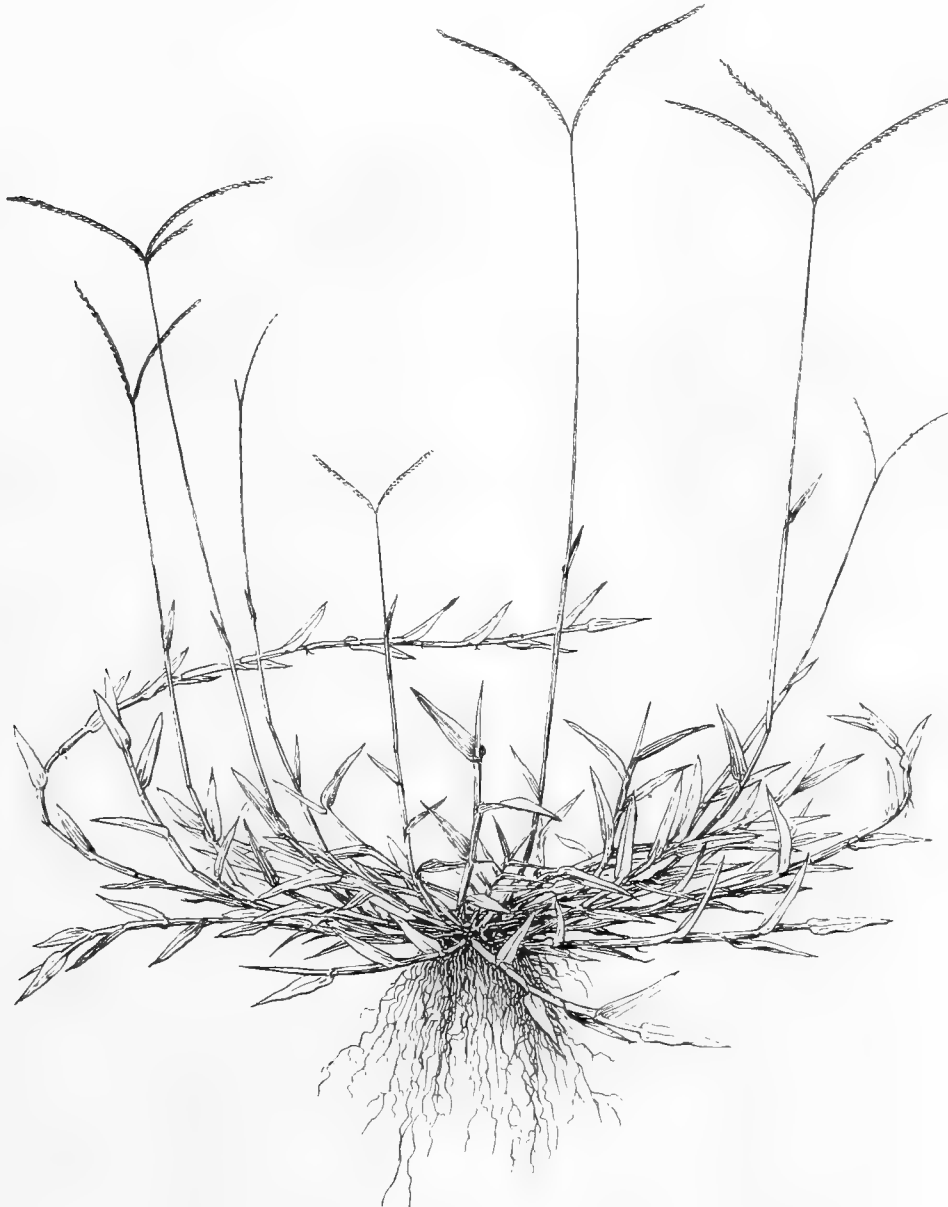


FIGURE 59.—*Syntherisma longiflora*. From Hitchcock 14186, Hawaii.



FIGURE 61.—*Syntherisma chinensis*. From Hitchcock
10328, Trinidad, W. Ind.



FIGURE 60.—*Valota insularis*. From U. S. Dept. Agr.
Bull. 772, fig. 129.

Along a moist cut; introduced. Originally described from India.
Hawaii: Hilo, Hitchcock 14186.

2. *Syntherisma chinensis* (Nees).

Paspalum chinensis Nees in Hook. & Arn. Bot. Beechey Voy. 231. 1841.

Paspalum minutiflorum Steud. Syn. Pl. Glum. 1:17. 1854. Not *Paspalum minutiflorum* Desv. 1831.

Syntherisma helleri Nash, Minn. Bot. Stud. 1:798. pl. 44. 1897.

Culms erect, or decumbent at base, glabrous, slender, 20 to 60 cm. tall; sheaths glabrous, compressed-keeled; ligule a short membrane less than 1 mm. long; blades linear, 5 to 15 cm. long, 3 to 5 mm. wide, glabrous, scabrous on the margins, sparingly pilose at base; racemes 2 to 6, slender, often curved, 4 to 10 cm. long, approximate at the summit of the culm, the rachis narrowly winged, glabrous, scabrous on the margins; spikelets elliptic, 1.5 mm. long, the longer pedicel terete, scabrous, less than 1 mm. long; first glume wanting; second glume and sterile lemma about equal, obscurely appressed-silky between the nerves, the glume 3-nerved, the lemma 5-nerved; fruit acute, as long as spikelet, brown (fig. 61).

This species was referred to *S. longiflora* (Retz.) Skeels by Hitchcock and Chase,¹³ to *Digitaria violascens* Link by Merrill,¹⁴ and to *Panicum filiforme* L. by Hillebrand¹⁵ as is shown by a specimen in the Gray Herbarium from a "Valley behind Honolulu, Oahu," collected by the Wilkes Expedition and cited by Hillebrand.

A weed in fields, grassland and waste places; introduced. Originally described from China.

Kauai: Olokele Gulch, Hitchcock 15260.

Oahu: Honolulu, Hitchcock 13712; Hauula, Farmer 16. Kalihi Valley, Hitchcock 14107. Mt. Tantalus, Hitchcock 13863. Schofield Barracks, Hitchcock 13941, 13977. Pauoa, Heller 2321 (type collection of *Syntherisma helleri*).

Molokai: Pukoo, Hitchcock 15065. Kahanui, Forbes 261.

Maui: Olinda, Hitchcock 14937.

Hawaii: Kilauea, Faurie 1300. Hilo, Hitchcock 14169, 14188; Newell in 1917.

3. *Syntherisma pruriens* (Trin.) Arthur, Torrey 19:83. 1919.

Panicum pruriens Trin. Gram. Pan. 77. 1826.

Digitaria consanguinea Gaud. in Freyc. Voy. Uran. Bot. 410. 1830.

Digitaria pruriens Busse in Miq. Pl. Jungh. 379. 1854.

Paspalum sanguinale var. *pruriens* Hook. f. Fl. Brit. Ind. 7:15. 1896.

Syntherisma consanguinea Skeels. U. S. Dept. Agr. Bur. Pl. Ind. Bull. 282:33. 1913.

Culms decumbent at base, as much as 1 meter tall, glabrous; sheaths pilose, often densely so; ligule rather prominent, membranaceous, 2 mm. long; blades flat, lax, mostly 10 to 15 cm. long, about 5 to 10 mm. wide, scabrous, hispid or sometimes velvety-pubescent; racemes several at the summit of the culm, erect, scarcely spreading even at maturity, 10 to 15 cm. long; rachis winged, the margins scabrous; spikelets lanceolate, acute, 3 mm. long; first glume wanting, or a mere ridge, sometimes as much as 0.2 mm. long; second glume oblong, obtuse, about 1 mm.

¹³ Hitchcock, A. S., and Chase, Agnes, Grasses of the West Indies: Contr. U. S. Nat. Herb. Vol. 18, p. 294, 1917.

¹⁴ Merrill, E. D., An enumeration of Philippine Graminae: Philippine Jour. Sci. Vol. 1, Suppl. 5, p. 347, 1906.

¹⁵ Op. cit., p. 495.



FIGURE 62.—*Syntherisma pruriens*. From Hitchcock
14190, Hawaii.



FIGURE 63.—*Paspalum fimbriatum*. From Small & Carter
8926, Bahamas.

long, villous on the margins; sterile lemma as long as the spikelet, about 5-nerved, the lateral nerves villous; fertile lemma as long as the spikelet, pale (fig. 62).

This species differs from *S. sanguinalis* in the erect racemes and the shorter glumes.

A weed in shady moist rich soil; introduced. Originally described from Hawaii and the Marquesas Islands ("Inss. Sandw. et Marchion.").

Kauai: Kaloko Reservoir, Forbes 582. Olokele Gulch, Hitchcock 15257.

Oahu: Makiki, Heller 1972. Honolulu, Hitchcock 13735. Mt. Tantalus, Hitchcock 13862.

Hawaii: Hilo, Hitchcock 14190; Newell in 1917. Kukuihaele, Rock 4545. Southeast coast of Puna, Wilkes Expl. Exped. (Gray Herbarium. In this specimen the sheaths are glabrous or very sparsely beset with papillae.)

4. *Syntherisma sanguinalis* (L.) Dulac, Fl. Haut. Pyr. 77. 1867.

Panicum sanguinale L. Sp. Pl. 57. 1753.

Digitaria sanguinalis Scop. Fl. Carn. ed. 2. 1:52. 1772.

Culms usually decumbent-spreading, often rooting at the nodes, as much as 1 meter long, glabrous; sheaths, at least the lower, papillose-hispid; ligule a short membrane; blades flat, lax, 5 to 15 cm. long, 5 to 10 mm. wide, scabrous, more or less pilose at base; racemes several, mostly 3 to 10, rarely 2, digitate or with 1 or 2 fascicles below the summit, 3 to 15 cm. long, more or less spreading at maturity; rachis winged, the green wings about as broad as the whitish center, scabrous on the margins; spikelets 3 mm. long, lanceolate, acute; first glume evident, triangular-acute, about 0.5 mm. long; second glume narrow, 3-nerved, about two-thirds as long as the spikelet, prominently villous on the margins and often also on the internerves; sterile lemma as long as the spikelet, 5 to 7-nerved, usually 3 nerves on the flat face of the spikelet, the marginal nerves more or less silky-villous, the hairs appressed at first, often spreading and prominent at maturity; fertile lemma pale, acute (fig. 64).

A weed in fields and waste places; introduced. Originally described from Europe.

Kauai: Lihue, Forbes 466.

Oahu: Honolulu, Forbes 1714; Hitchcock 13683. Slopes of Kaala, Forbes in 1912. Pauoa, Heller 2320.

Hawaii: Hilo, Hitchcock 14191; Newell in 1917. Without locality, Mann & Brigham.

5. *Syntherisma debilis* (Desf.) Skeels, U. S. Dept. Agr. Bur. Pl. Ind. Bull. 261:30. 1912.

Panicum debile Desf. Fl. Atl. 1:59. 1798.

Digitaria debilis Willd. Enum. Hort. Berol. 91. 1809.

Culms weak and slender, erect or decumbent at base; sheaths glabrous or sparsely pilose; ligule thin, truncate-erose, 2 mm. long; blades flat, lax, scabrous, 5 to 10 cm. long, 2 to 5 mm. wide; racemes mostly 2 to 4, ascending or spreading, 2 to 3 approximate at the summit and sometimes one a short distance below, 3 to 8 cm. long; rachis narrow, 0.5 mm. wide, narrowly winged, scabrous; spikelets lanceolate, acute, 3 mm. long; first glume wanting or only about 0.2 mm. long; second glume about half as long as the spikelet, narrow, acute, slightly villous along the margin; sterile lemma as long as the spikelet, about 7-nerved, glabrous; fertile lemma pale.

A weed in waste places; introduced. Originally described from the Mediterranean region.



FIGURE 64.—*Syntherisma sanguinalis*. From U. S. Dept. Agr. Bull. 772, fig. 130.



FIGURE 65.—*Paspalum distichum*. From U. S. Dept. Agr. Div. Agrost. Bull. 7, fig. 25.



FIGURE 66.—*Stenotaphrum secundatum*. From U. S. Dept. Agr. Bull. 772, fig. 132.

Hawaii: Hilo, Newell in 1917.

6. **Syntherisma microbachne** (Presl).

Panicum microbachne Presl, Rel. Haenk. 1:298. 1830.

Culms ascending from a spreading and rooting base, as much as 1 meter long; sheaths papillose-hispid; ligule thin, truncate-erose, prominent, 3 mm. long; blades flat, lax, narrowed at base, 10 to 20 cm. long, more or less pilose; racemes several, 7 to 15 cm. long, ascending or spreading, somewhat scattered, the main axis 3 to 5 cm. long; rachis winged, scabrous; spikelets lanceolate, acute, 3 mm. long; first glume wanting or a mere ridge or a minute bract 0.2 mm. long; second glume oblong, obtuse, about 0.5 mm. long; sterile lemma slightly exceeding the spikelet, 7-nerved, two pairs of nerves close together on the infolding edges, the margins silky-pubescent; fertile lemma pale.

This species has the aspect of *S. sanguinalis* but differs in the short glumes.

A weed in gardens; introduced. Original locality unknown, probably the Philippines.

Hawaii: Hilo, Newell in 1917.

34. **STENOTAPHRUM** Trin.

Spikelets embedded in one side of an enlarged and flattened corky rachis disarticulating at maturity, the spikelets remaining attached; first glume small; second glume and sterile lemma about equal, the latter with a palea or staminate flower; fertile lemma chartaceous. Creeping stoloniferous perennials, with short flowering stems, rather broad and short obtuse blades, and terminal and axillary racemes.

1. **Stenotaphrum secundatum** (Walt.) Kuntze, Rev. Gen. Pl. 2:794. 1891.

Ischaemum secundatum Walt. Fl. Carol. 249. 1788.

Stenotaphrum americanum Schrank, Pl. Rar. Hort. Monac. pl. 98. 1819.

Plants extensively creeping, glabrous, the stolons with long internodes and short leafy branches; sheaths equitant; blades short, obtuse; flowering culms 10 to 30 cm. tall, the blades commonly 10 to 15 cm. long; racemes terminal and axillary, 5 to 10 cm. long (fig. 66).

Grassy slopes; sometimes near the seashore. Tropical shores of both hemispheres.

Oahu: Nuuanu Pali, Heller 2359; Forbes 1522; Hitchcock 13768. Valley behind Honolulu, Wilkes Expl. Exped. Without locality, Mann & Brigham 88.

Molokai: Pukoo, Hitchcock 15048.

Hawaii: Halawa, Faurie 1348; Hilo, Hitchcock 14152; Newell in 1917.

Without locality: Hillebrand 490.

35. **PASPALUM** L.

Spikelets plano-convex, usually obtuse, subsessile, solitary or in pairs, in two rows on one side of a narrow or dilated rachis, the back of the fertile lemma toward it; first glume generally wanting; second glume and sterile lemma commonly about equal, the former rarely wanting; fertile lemma usually obtuse, chartaceous-indurate, the margins inrolled. Mostly perennials, with one to many spikelike racemes, these single or paired at the summit of the culms or racemously arranged along the main axis.

Plants annual; spikelets with a broad stiff lacerate margin..... 1. **P. fimbriatum**.

Plants perennial; spikelets not lacerate-margined.

Racemes 2, conjugate at the summit of the culm, rarely a third below.

First glume present on at least some of the spikelets; spikelets elliptic..... 2. **P. distichum**.

First glume wanting; spikelets orbicular in outline..... 3. **P. conjugatum**.



FIGURE 67.—*Paspalum conjugatum*. From Baker 90, Cuba.

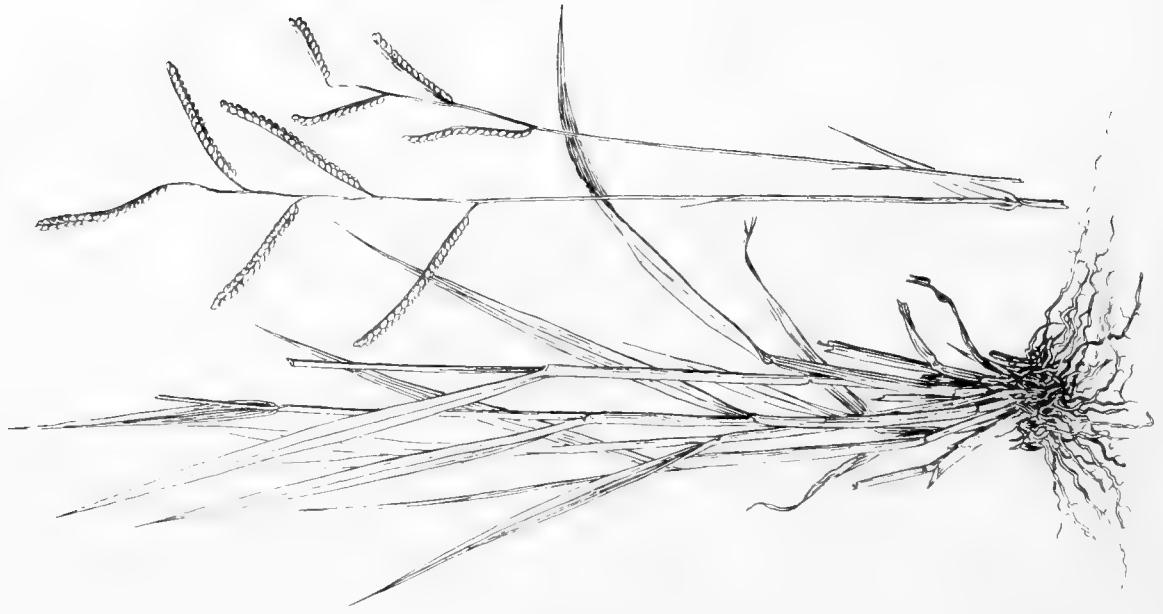


FIGURE 68.—*Paspalum orbiculare*. From Hitchcock 14102, Hawaii.

Racemes more than 2, racemosely arranged.

Spikelets glabrous.....4. **P. orbiculare.**

Spikelets pubescent.

Spikelets 3 to 3.5 mm. long; racemes few to several, more or less spreading.....5. **P. dilatatum.**

Spikelets 2 mm. long; racemes usually numerous, suberect.....6. **P. larranagai.**

1. **Paspalum fimbriatum** H. B. K. Nov. Gen. & Sp. 1:93. 1816.

Plants annual; culms erect, rather soft, 30 to 60 cm. tall; sheaths glabrous; blades flat, glabrous, 5 to 20 cm. long, 5 to 10 mm. wide; racemes few, erect or ascending, 3 to 5 cm. long, the rachis nearly 2 mm. wide; spikelets orbicular-ovate, glabrous, 2 mm. long, with a broad, stiff, lacerate margin (fig. 63).

A weed along roadsides; introduced. Originally described from Colombia.
Oahu: Honolulu, Hitchcock 13672, 15561.

2. **Paspalum distichum** L. Syst. Nat. ed. 10. 2:855. 1759.

Culms erect from a decumbent rooting base, with numerous creeping rhizomes, glabrous, or the nodes pubescent, 30 to 60 cm. tall; sheaths glabrous or pubescent; blades flat, glabrous, or rarely pubescent, 5 to 10 cm. long, the upper shorter; racemes commonly 2, one sessile, the other slightly peduncled, in some plants a third below these, all more or less pilose at base, ascending or appressed, 3 to 5 cm. long; spikelets elliptic, 3 mm. long; first glume variable in length, or wanting on the lower spikelets, glabrous; second glume pubescent; sterile lemma glabrous (fig. 65).

Marshes near sea; probably introduced. Tropics of both hemispheres. The source of Linnaeus's specimen is unknown.

Oahu: Waikiki, Hitchcock 13803.

3. **Paspalum conjugatum** Bergius, Act. Helv. Phys. Math. 7:129. 1762. HILO GRASS.

Culms erect from a decumbent base mostly 30 to 60 cm. tall, producing extensively creeping leafy stolons; sheaths glabrous; blades flat, 5 to 15 cm. long, 5 to 10 mm. wide; racemes 2, conjugate, slender and spreading, 5 to 10 cm. long or even longer, villous at the base, the rachis about 0.5 mm. wide; spikelets yellow, orbicular-ovate, about 1.5 mm. long, sparsely silky-villous along the margin (fig. 67).

Roadsides, waste places and moist grassland; introduced. Very abundant in the zone below moist forests. Tropics of both hemispheres. Originally described from Dutch Guiana.

Oahu: Honolulu, Hitchcock 13729, 14067. Nuuanu Valley, Forbes in 1908.

Slopes of Makiki, Heller 1975. Hauula, Farmer in 1895.

Hawaii: Paauhau, Rock in 1909. Hilo, Hitchcock 14182; Newell in 1917.

Without locality: Hillebrand 492.

4. **Paspalum orbiculare** Forst. Florul. Ins. Austr. Prodr. 7. 1786.

Plants perennial, glabrous throughout; culms erect, as much as 1 meter tall; blades narrow, erect or ascending, 10 to 25 cm. long, 5 to 8 mm. wide, flat; racemes mostly 4 to 6, spreading, 3 to 5 cm. long, distant on the axis 1 to 3 cm., the rachis 1 mm. wide; spikelets tawny or brownish, closely imbricate, glabrous, broadly elliptic, 2 mm. long; fruit brownish (fig. 68).



FIGURE 69.—*Paspalum dilatatum*. From Hitchcock in 1903, Louisiana.



FIGURE 70.—*Paspalum larranagai*. From Chase 4388, Louisiana.

Moist grassy slopes, common in the belt below the forest; apparently introduced. Originally described from the Society Islands.

Kauai: Lihue, Forbes 479.

Oahu: Hauula, Farmer 11. Nuuanu Pali, Hitchcock 13792. Makiki, Heller 1971. Schofield Barracks, Hitchcock 13930, 13935, 13978. Mountains east of Schofield Barracks, Hitchcock 14020. Mt. Tantalus, Hitchcock 13879. Manoa Valley, Hitchcock 13730. Honolulu, Forbes 1717. Without locality, Mann & Brigham 59; Remy 103; Seeman 2249 (last two in Gray Herbarium).

Molokai: Pukoo, Hitchcock 15054.

Hawaii: Hilo, Hitchcock 14192; Newell in 1917. Kukuihaele, Rock 4527.

5. *Paspalum dilatatum* Poir. in Lam. Encycl. 5:35. 1804.

Plants perennial; culms erect, 50 to 100 cm. tall; sheaths glabrous, or the lower villous; blades glabrous, flat, 10 to 25 cm. long, mostly 5 to 8 mm. wide, often pilose at base; racemes mostly 4 to 6, 3 to 7 cm. long, rather lax and spreading, pilose at the base, the lower distant 2 to 3 cm., the rachis 1 mm. wide; spikelets ovate, 3 to 3.5 mm. long, silky-villous on the margins (fig. 69).

Along roadsides and in grassland; escaped from cultivation. Originally described from Argentina.

Kauai: Lihue, Forbes 737.

Oahu: Honolulu, near United States Experiment Station, Hitchcock 14072. Schofield Barracks, Hitchcock 13981.

Molokai: Central part, Hitchcock 15153.

Hawaii: Papaaloa, Forbes 325. Kukaiau Ranch, Hitchcock 14214. Hilo, Newell in 1917.

This species is proving of value as a pasture grass in the grazing areas of the southern islands at medium altitudes, 2000 to 6000 feet.

6. *Paspalum larranagai* Arech. Ann. Mus. Nac. Montevideo 1:60. pl. 2. 1894.

Paspalum vaseyanum Scribn. U. S. Dept. Agr. Div. Agrost. Bull. 17:32. fig. 328. 1899.

Plants perennial; culms erect, 1 to 1.5 meters tall; sheaths glabrous, or the lower hispid, pilose around the throat; blades flat, 15 to 30 cm. long, about 1 cm. wide, glabrous; inflorescence narrow, virgate, the racemes several to many, appressed or ascending, 3 to 10 cm. long, the rachis 1 mm. wide; spikelets ovate, 2 mm. long, densely long-silky on the margins (fig. 70).

This species differs from *P. dilatatum* in the more numerous racemes, virgate panicle, and smaller and more silky spikelets. It is found in the United States from North Carolina to Texas. Probably introduced.

Along roadside; introduced or escaped from cultivation. Originally described from Uruguay.

Oahu: Manoa Valley, Hitchcock 13737, 14081.

36. *PANICUM* L.

Spikelets more or less compressed dorsiventrally, arranged in open or compact panicles, rarely in racemes; glumes 2, herbaceous, nerved, commonly very unequal, the first generally minute, the second typically equaling the sterile lemma, the latter of the same texture and simu-

lating a third glume, bearing in its axil a membranaceous or hyaline palea and sometimes a staminate flower, the palea rarely wanting; fertile lemma chartaceous-indurate, typically obtuse, the nerves obsolete, the margins inrolled over an inclosed palea of the same texture, a lunate line of thinner texture at the back just above the base, the rootlet protruding through this at germination. Annual or perennial grasses, of various habit.

Plants annual.

Spikelets glabrous..... 1. *P. fauriei*.

Spikelets pubescent.

Spikelets densely long-villous.

Culms and leaves glabrous or puberulent, the nodes bearded..... 2. *P. beecheyi*.

Culms and leaves densely soft-villous..... 3. *P. torridum*.

Spikelets sparsely short-villous or densely long-villous only at the tip.

Culms and leaves puberulent or glabrous.

Spikelets with a tuft of long hairs at apex; leaves puberulent..... 4. *P. nubigenum*.

Spikelets sparsely villous all over; leaves glabrous..... 5. *P. kauaiense*.

Culms and leaves villous or hispid.

Leaves papillose-hispid; spikelets acuminate, 2.5 mm. long..... 6. *P. pellitum*.

Leaves densely short-villous; spikelets acutish, 1.5 mm. long 7. *P. lanaiense*.

Plants perennial.

Rhizomes or stout stolons present.

Panicle made up of several densely flowered racemes; stems decumbent and rooting at base, sending out stout stolons..... 9. *P. barbinode*.

Panicle open; creeping rhizomes present.

Fertile lemma smooth; culms mostly single..... 8. *P. repens*.

Fertile lemma minutely transversely rugose; culms tufted..... 10. *P. maximum*.

Rhizomes and stout stolons wanting.

First glume as long as the spikelet or a little shorter, acuminate.

Blades glabrous, flat, about 1 cm. wide..... 11. *P. nephelophilum*.

Blades pubescent, flat or involute.

Blades 1 to 1.5 cm. wide, velvety-pubescent, flat..... 12. *P. kaalaense*.

Blades mostly less than 5 mm. wide, pilose hirsute, flat or involute.

Spikelets about 2 mm. long; blades mostly flat, lax..... 13. *P. xerophilum*.

Spikelets about 3 mm. long; blades often involute, stiff..... 14. *P. tenuifolium*.

First glume short, in one species as much as half or two-thirds as long as the spikelet, obtuse; plants forming low dense tussocks or mats in bogs.

Blades conspicuously ciliate, broad, short, closely imbricate..... 15. *P. isachnoides*.

Blades not ciliate.

Spikelets 2 mm. long or a little less, the first glume less than half as long; plants in close dense tufts, the blades short and spreading, closely imbricate..... 16. *P. imbricatum*.

Spikelets more than 2 mm. long, the first glume short or as much as two-thirds the length of the spikelet; plants less densely tufted and blades as a rule not closely imbricate.

Spikelets about 3 mm. long; first glume short..... 17. *P. hillebrandianum*.

Spikelets 2.2 to 2.5 mm. long; first glume short or long.

First glume about one-fourth the length of the spikelet; fruit nearly as long as the second glume..... 18. *P. forbesii*.

First glume half to two-thirds as long as the spikelet; fruit much shorter than the second glume..... 19. *P. cynodon*.

1. *Panicum fauriei* sp. nov.

Plants annual, bushy-branched; culms puberulent, branched at all the nodes, 10 to 15 cm. tall; sheaths puberulent; ligule a densely ciliate membrane, the hairs nearly 1 mm. long; blades flat or more or less involute, 2 to 5 cm. long, about 1 mm. wide, appressed-hispidulous beneath, appressed villous on upper surface; panicles numerous, narrow, rather few-flowered, 1 to 3 cm.

long, yellowish, the axis and appressed pedicels angled, short-villous with ascending hairs; spikelets glabrous, about 2 mm. long; glumes equal, lanceolate, acute, 5-nerved; sterile lemma a little shorter than the glumes, rather thin, 5-nerved, the palea oval, about half as long as the lemma; fertile lemma acute, 1.5 mm. long; palea nearly hidden by the margins of the lemma (fig. 71).

Type in the U. S. National Herbarium, no. 950341, collected at Halawa, Island of Hawaii, June, 1909, by Abbé Faurie (no. 1318).

There are no data on the labels to indicate the habitat of the specimens, except from Hitchcock's no. 15145, which grew on a sandy seabeach.

Dr. Stapf has kindly sent me a fragment from a specimen in the Kew Herbarium labeled "Sandhills. Wailuku, Maui, Wilkes Exped." This appears to be the same as the specimen listed below which is without data other than "Sandwich Islands," but the character of the label and the handwriting indicate a collection of the Wilkes Expedition. In the Gray Herbarium is a duplicate of the one in the Kew Herbarium.

Molokai: West end, sandy beach, Hitchcock 15145.

Hawaii: Halawa, Faurie 1318.

Without locality: "Sandwich Islands," U. S. National Herbarium no. 974867.



FIGURE 71.—*Panicum fauriei*. From the type specimen.

FIGURE 72.—*Panicum nubigenum*. From Forbes 2447, Oahu.

2. *Panicum beecheyi* Hook. & Arn. Bot. Beechey Voy. 100. 1841.

Plants annual; culms branching and spreading, 20 to 30 cm. tall, glabrous, scaberulous, or puberulent, the nodes villous; sheaths glabrous, shorter than the internodes; ligule a very short membrane with a line of hairs about 1 mm. long; blades glabrous or scaberulous, 4 to 10 cm. long, 2 to 4 mm. wide; panicles numerous, narrow, lanceolate or linear, 5 to 10 cm. long, white or tawny, more or less inclosed in the uppermost sheaths, the axis and branches angled,



FIGURE 75.—*Panicum pellitum*. From Rock
8708, Maui.



FIGURE 74.—*Panicum torridum*. From Munro
in 1916, Lanai.



FIGURE 73.—*Panicum beecheyi*. From Munro
in 1917, Lanai.

scabrous and somewhat villous; spikelets acuminate, 4 mm. long, the lower half hidden by the dense pubescence; glumes equal, 5-nerved, acuminate, the lower two-thirds densely long-villous, the hairs spreading, 1 to 2 mm. long, the upper third pubescent only; sterile lemma a little shorter than the glumes, 7-nerved, pubescent, or appressed-villous toward the apex, the palea wanting; fertile lemma rather thin, oblong-elliptic, 2 mm. long, the palea enclosed only at the margins (fig. 73).

Open dry plains of lee side. Originally described from the "Sandwich Islands."

Molokai: North coast, G. C. Munro in 1903.

Lanai: Kahalepaloa, Munro 6 and 6b in 1917. Maneli, Munro in 1917; May 2, 1918.

3. *Panicum torridum* Gaud. in Freyc. Voy. Uran. Bot. 411. 1830.

Panicum cinereum Hillebr. Fl. Haw. Isl. 500. 1888.

Plants annual; culms erect, or branched and decumbent at base, 20 to 60 cm. tall, or even taller, densely soft-pubescent or villous; sheaths and blades soft-pubescent or villous like the culms; ligule a short ciliate membrane about 1 mm. long; blades 10 to 20 cm. long, as much as 1 cm. wide; panicle green or tawny, oblong-elliptic, rather densely flowered, 3 to 15 cm. long, 1 to 4 cm. wide, the approximate branches ascending, closely flowered; spikelets 3 mm. long, acuminate; glumes nearly equal, acuminate, the first a little shorter, 3 to 5-nerved, the second 5 to 7-nerved, both villous with ascending or spreading hairs 2 to 3 mm. long from papillae, the hairs not dense enough to hide the glumes; sterile lemma acute, as large as the first glume except the acuminate point, 7-nerved, glabrous, or sparsely villous on upper part, the palea triangular-acute, about half as long as the lemma; fertile lemma 1.5 mm. long, the palea inclosed only at the margins (fig. 74).

Hillebrand describes this species as having a hairy sterile lemma. In our specimens the sterile lemma is usually glabrous. In some specimens, *e. g.*, Wilkes Exped., labeled "*P. pellitum*," and Forbes 2415, which appear to differ in no other respect, the sterile lemma is pilose on the upper part.

We have seen no authentic specimens of *Panicum cinereum*, though a Mann and Brigham specimen has been so labeled (cited below). From the description it appears to be referable to *P. torridum*, except for the peculiar ligule. Hillebrand says, "sheath ending in the blade with a broad beak-like truncate projection of about 6" [6 lines or 12 mm.] in length, the ligule forming a thick woolly border to it." This may be an abnormality or his specimen might have included an admixture of something else.

Dry plains, chiefly on lee side of islands. Originally described from "insulis Sandwicensibus." *Panicum cinereum* was described from "Maui! Haleakala (Prof. Alexander)."

Oahu: Koko Head, Mann & Brigham; Forbes 1454, 2415, 2455, 2449. Laie, Mann & Brigham. Waialua Mountains, Mann & Brigham 272.

Molokai: Kauluwai, Rock 8704; Ka Lae o Ka Laau, Rock 2545.

Lanai: G. C. Munro, March 31, 1914; Forbes 150; Miki, G. C. Munro, December, 1916; west end of island, Hitchcock 14719; Nahua, G. C. Munro, December, 1916.

Maui: Sand hills, East Maui. Wilkes Expl. Exped.

Hawaii: Without locality, Mann & Brigham.



FIGURE 76.—*Panicum kaulaense*. From the type specimen.



FIGURE 77.—*Panicum repens*. From Hitchcock 14154, Hawaii.

4. *Panicum nubigenum* Kunth, Enum. Pl. 1:98. 1833.

Panicum montanum Gaud. Voy. Uran. Bot. 411. 1830 (title page 1826). Not *Panicum montanum* Roxb. 1820.

Neurachne montanum Gaud. Voy. Uran. Bot. Atlas pl. 26. 1830.

Plants annual; culms commonly much branched and spreading, 10 to 30 cm. tall, puberulent, more or less villous at the nodes; sheaths puberulent; ligule a dense line of hairs 1 to 2 mm. long; blades flat or involute, mostly less than 10 cm. long, 1 to 2 mm. wide, puberulent beneath, pilose on the upper surface, subulate-pointed; panicles numerous, greenish or tawny, narrow, 1 to 5 cm. long, usually included at base in the uppermost sheath, the branches appressed, angled, pilose; spikelets about 2.5 mm. long, acuminate; glumes pubescent, the acuminate apex pilose, the erect hairs forming a terminal tuft, the first a little longer, 5-nerved, the second 7-nerved; sterile lemma a little shorter than the glumes, glabrous, 7-nerved, the palea elliptic, one-third as long as the lemma; fertile lemma 1.5 mm. long, 7-nerved, the palea inclosed at the margins (fig. 72).

Dry plains and slopes. Originally described from "Insulis Sandwicensibus."

Oahu: Mokolii Island, Rock 12766; Koko Head, Forbes 2414, 2447.

Molokai: Without locality, Stokes in 1909.

Lanai: Mamali, G. C. Munro, April 23, 1917. Kahalepaloa, G. C. Munro, Mar. 6, 1917.

Hawaii: Without locality, Wilkes Explor. Exped.

5. *Panicum kauaiense* sp. nov.

Plants annual, glabrous except the spikelets; culms branching at base, 30 cm. tall; ligule about 0.5 mm. long, a short membrane dissected into hairs; blades flat, involute at the long and slender point, 10 to 15 cm. long, 1 to 3 mm. wide; panicles tawny, narrow, 5 to 8 cm. long, the axis and branches scabrous, the lower branches as much as 5 cm. long; spikelets narrow, acuminate, 3 mm. long, pubescent, appressed along the branches; glumes acuminate, pilose, the hairs ascending as much as 1 mm. long; first glume a little shorter than the second, about 5-nerved, the second 7-nerved; sterile lemma intermediate in length between the glumes, glabrous, 7-nerved, the palea narrow, about one-fourth as long as the lemma; fertile lemma narrow, acute, 1.7 mm. long (fig. 76).

Type in the U. S. National Herbarium, no. 836228, collected in Haupu Range, near Nawiliwili Bay, Kauai, Hawaiian islands, October 31, 1916, by C. N. Forbes (no. 703).

A collection from East Maui by the Wilkes Expedition appears to be this species but differs in having the leaves minutely hispidulous and the nodes slightly villous.

6. *Panicum pellitum* Trin. Gram. Pan. 198. 1826; Sp. Gram. 2: pl. 237. 1829.

Panicum gossypina Hook. & Arn. Bot. Beechey Voy. 100. 1841.

Plants annual; culms erect or decumbent at base, 30 to 50 cm. tall, glabrous or pubescent, the nodes pilose; sheaths papillose-pilose or glabrescent; ligule a line of hairs 1 mm. long; blades flat, 5 to 15 cm. long, as much as 5 mm. wide, pilose; panicle 10 to 15 cm. long, rather loose, the branches ascending, as much as 10 cm. long; spikelets appressed, acuminate, 2 mm. long or, because of the longer point, 3 mm. long; glumes about equal, pilose on the upper part with a few hairs 1 mm. long from a papillose base, the first 3-nerved, the second 5-nerved; sterile lemma a little shorter than the glumes, glabrous, 7-nerved, the palea oval, one-third as long as the lemma; fertile lemma 1.2 mm. long (fig. 75).

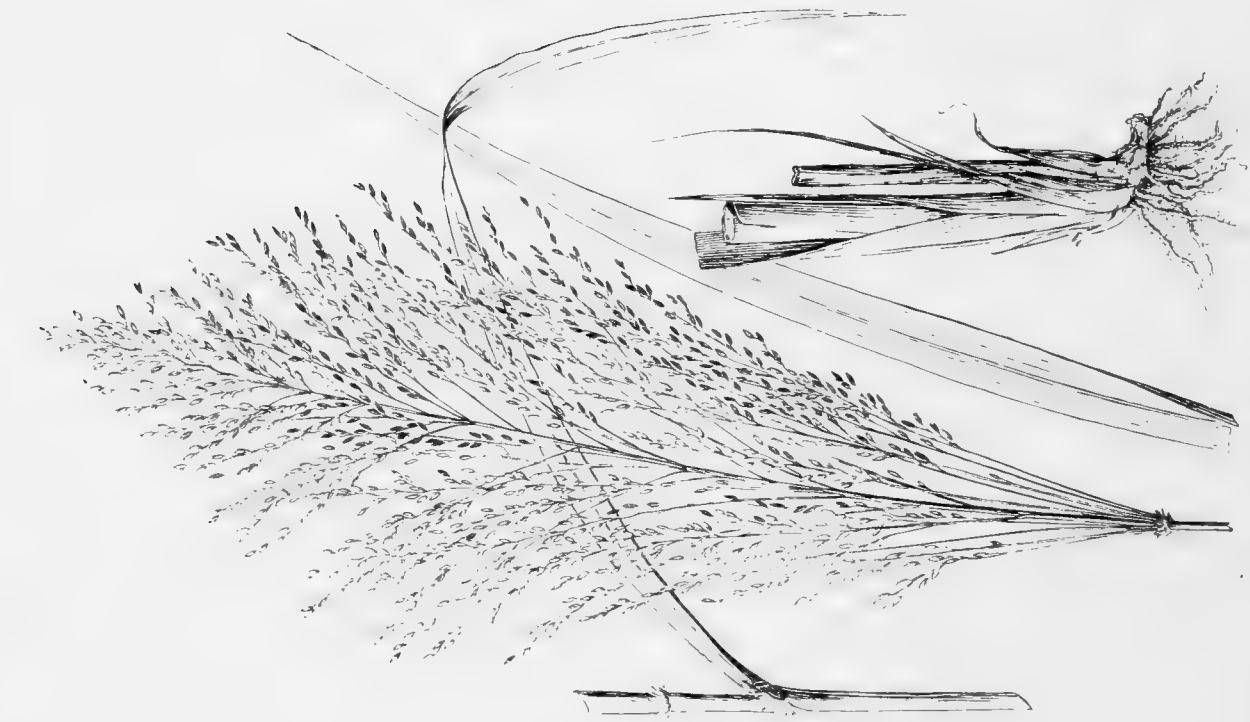


FIGURE 78.—*Panicum maximum*. From Combs & Baker 1170, Cuba.



FIGURE 79.—*Panicum barbinode*. From Hitchcock 9693, Jamaica.

Originally described from "Inss. Sandw. (Chamisso)."
Maui: Haleakala, Rock 8708.

7. *Panicum lanaiense* nom. nov.

Panicum affine Hook. & Arn. Bot. Beechey Voy. 100. 1841. Not *Panicum affine* Poir. 1816, nor Nees 1829.

Plants annual; culms 20 to 40 cm. tall, erect or decumbent at base, sometimes much branched at base, villous; sheaths villous; ligule a short ciliate membrane; blades ascending, flat, villous on both surfaces, 10 to 15 cm. long, 2 to 5 mm. wide; panicles numerous, open, 3 to 10 cm. long, the branches pilose, ascending or spreading; spikelets 1.5 mm. long, acutish, appressed along the branchlets; glumes about equal, pilose, especially toward the upper part, with a few long hairs as much as 1 mm. long, the first 3-nerved, the second 5-nerved; sterile lemma 7-nerved, glabrous, about as long as the glumes, the palea oval, about one-third as long as the lemma; fertile lemma broadly elliptic, 1.2 mm. long, turgid (fig. 86).

Panicum affine Hook. & Arn. was described from "Sandwich Islands."

Open ground in dry places on lee side of the islands. *Panicum affine* Hook & Arn. was described from "Sandwich Islands."

Kauai: Waimea, 2000 to 3000 feet, Mann & Brigham 383.

Lanai: Miki Plain, Munro in 1916.

Maui: Sand hills, Wailuku, Wilkes Expl. Exped.

Without locality: Hance 4926 (Gray Herbarium). In the Gray Herbarium is a specimen with glabrous spikelets bearing a printed label, "*Panicum pellitum* Trin. cum varr. Ins. Sandwich."

8. *Panicum repens* L. Sp. Pl. ed. 2. 1:87. 1762.

Plants perennial from stout branching creeping rhizomes; culms erect, 30 to 80 cm. tall, clothed at base with bladeless overlapping sheaths; blades flat or folded, 4 to 15 cm. long, 2 to 5 mm. wide, pilose on the upper surface toward the base; panicle 7 to 12 cm. long, the somewhat distant branches stiffly ascending, usually naked at base, bearing short appressed branchlets with short-pediceled approximate spikelets toward the ends; spikelets about 2.5 mm. long, glabrous, ovate, abruptly pointed; first glume about one-fifth as long as the spikelet, truncate; second glume and sterile lemma equal, 5 to 7-nerved; fruit 1.8 mm. long (fig. 77).

Along bank of river in open ground; introduced. Originally described from the Old World.

Hawaii: Hilo, Hitchcock 14145; Newell in 1917.

9. *Panicum barbinode* Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 1:256. 1834. PARA' GRASS.

Plants perennial with long stout stolons; culms decumbent and rooting at base, often 2 meters or more long, glabrous, the nodes densely villous; sheaths softly or harshly villous or merely papillose or even glabrous, densely pubescent on the collar; ligule membranaceous, densely ciliate, about 1 mm. long; blades ascending or spreading, 10 to 30 cm. long, 10 to 15 mm. wide, glabrous; panicle 12 to 20 cm. long, about half as wide, the rather distant, subracemose, densely flowered branches ascending or spreading, the main axis and the somewhat flattened branches scabrous on the edges, densely pubescent in the axils; spikelets 3 mm. long, elliptic, glabrous; first glume one-fourth the length of the spikelet, acute, 1-nerved; second glume and sterile lemma subequal; fruit 2.5 mm. long, minutely transversely rugose (fig. 79).

Wet places; introduced. Originally described from Brazil where it was introduced from Africa.

Hawaii: Hilo, Hitchcock 14183; Newell in 1917.



FIGURE 80.—*Panicum kaalaense*. From the type specimen.



FIGURE 81.—*Panicum nephelophilum*. From Forbes 820, Kauai.

10. *Panicum maximum* Jacq. Coll. Bot. 1:76. 1786. GUINEA GRASS.

Plants perennial, tufted; culms robust, erect, glabrous, 1 to 2 meters tall, the nodes usually densely hirsute; sheaths papillose-hirsute to glabrous, usually pubescent on the collar; ligule 4 to 6 mm. long, stiffly and densely ciliate; blades erect or ascending, flat, 30 to 75 cm. long, 1 to 3.5 cm. wide, scabrous on the margin, glabrous on the surfaces or hirsute above near the base; panicle 20 to 50 cm. long, about one-third as wide, densely flowered, the long, rather stiff branches ascending, naked at base, the lower in whorls, the axils pilose, the branchlets short, appressed, bearing more or less clustered short-pedicelled spikelets; spikelets about 3 mm. long, oblong-ellipsoid, glabrous; first glume one-third as long as spikelet, obtuse; second glume and sterile lemma subequal, slightly exceeding the fruit, thin, the lemma with a staminate flower; fruit about 2.5 mm. long, transversely rugose (fig. 78).

Open ground along road; introduced. Originally described from Guadeloupe where it was introduced from Africa.

Oahu: Fort Shafter, Hitchcock 13858.

11. *Panicum nephelophilum* Gaud. in Freyc. Voy. Uran. Bot. 411. 1830.

?*Panicum pseudogrostis* Trin. Gram. Pan. 197. 1826.

Panicum havaense Reichardt, Sitzungsab. Akad. Wiss. Math. Naturw. (Wien) 76¹:723. 1878.

Plants perennial, tufted; culms erect, glabrous, usually 1 to 1.5 meters tall; sheaths papillose-pilose or glabrate; ligule a short membrane about 1 mm. long, densely ciliate with hairs 1 mm. long; blades flat, glabrous, scabrous, in some specimens ciliate on the margin, mostly 15 to 30 cm. long, 8 to 25 mm. wide; panicle open, in well-developed plants very large, as much as 50 cm. long and 30 cm. wide, the branches stiffly ascending, the lower in whorls, the axils often pubescent; spikelets narrow, 2 to 2.5 mm. long, glabrous, appressed along the branchlets on pedicels about their own length; glumes equal, the first acuminate, 5-nerved, the second acute, 7-nerved; sterile lemma a little shorter than the glumes, glabrous, about 9-nerved, the palea ovate, nearly half as long as the lemma; fertile lemma acute, about 1.7 mm. long (fig. 81).

Dr. Stapf has sent me a drawing of the Gaudichaud specimen. The sheaths are pilose.

Panicum pseudogrostis Trin., from "Ins. Sandw. (Chamisso herb.);" may belong to *Panicum nephelophilum* but the description does not agree in all respects. It is described as having a large panicle and leaves a foot long, and one-half inch wide, "hirtula". The pedicels are described as hispidulous, and the fertile lemma as having two appendages at base as in *Panicum* (*Ichnanthus*) *almadense*. The last statement does not apply to any of our species and may be an error. The pedicels of this species and the next are mostly glabrous, sometimes sparsely scaberulous, but not hispidulous. The blades of *P. nephelophilum* are glabrous and of *P. kaalaense*, velvety pubescent, but not hirtulous. *Panicum pseudogrostis* will be uncertain until the type is examined.

Moist or dry woods, mostly at upper altitudes. Originally described from "Insulis Sandwicensibus."

Kauai: Kaholuamano, Rock 12638; Hitchcock 15284, 15436; Heller 2850; Halemanu, Forbes 820; Waimea, 2000 to 3000 feet, Mann & Brigham 300; Searle in 1900.

Oahu: Mt. Kaala, Hitchcock 14014.

Molokai: Without locality, Forbes 379.

Lanai: Munro 272, 334, 467.

12. *Panicum kaalaense* sp. nov.

Plants perennial, tufted; culms erect, more or less pubescent or villous, 60 to 150 cm. tall, the nodes villous; sheaths villous; ligule membranaceous, 1 mm. long, extending into cilia 1 mm.



FIGURE 82.—*Panicum tenuifolium*. From Hitchcock 14208, Hawaii.

FIGURE 83.—*Panicum xerophilum*. From Munro in 1916, Lanai.

long; blades flat, velvety-pubescent, 10 to 40 cm. long, 8 to 15 mm. wide, rounded at the base, acuminate at apex, scabrous on the margins; panicle 15 to 35 cm. long, as much as 20 cm. wide, the branches ascending, pubescent in the axils, often purple; spikelets narrow, 2.5 to 3 mm. long, acuminate, glabrous; first glume acuminate, 5-nerved; second glume a little shorter than the first, acute, 7-nerved; sterile lemma slightly shorter than the glumes, 7-nerved, the palea ovate, about one-third as long as the lemma; fertile lemma 2 mm. long (fig. 80).

Type in the U. S. National Herbarium, no. 836474, collected on a wooded hillside on Mount Kaala, at about 1000 meters, July 9, 1916, by A. S. Hitchcock (no. 14013).

This species differs from *P. nephelophilum* in the villous culms and sheaths, the velvety pubescent blades and the slightly larger spikelets and fruit.

Damp woods.

Kauai: Halemanu, Forbes 775.

Oahu: Mt. Kaala, Hitchcock 14013; Hillebrand in 1856. Palehua, Waianae Range, Forbes 1693. Makaleha Ridge, Rock 17082.

Molokai: Slopes of Puu Kolekole, Forbes 218.

Maui: Sand hills, Wailuku, Wilkes Expl. Exped. (Gray Herbarium).

Hawaii: Puu Waawaa, Hitchcock 14475.

13. *Panicum xerophilum* (Hillebr.).

Panicum nephelophilum γ var. *xerophilum* Hillebr. Fl. Haw. Isl. 498. 1888.

Plants perennial; culms slender, erect, more or less pilose, 15 to 30 cm. tall, the nodes villous; sheaths papillose-pilose; ligule pilose, the hairs 2 to 3 mm. long; blades flat, 5 to 15 cm. long, 1.5 to 3 mm. wide, rather lax, pilose, especially on upper surface; panicle open, 5 to 15 cm. long, oblong, the branches ascending; spikelets 2 mm. long, glabrous, appressed along the branchlets; glumes equal, acute, 5-nerved; sterile lemma about as long as the glumes, 7-nerved, the lemma ovate-acuminate, half as long as the lemma; fruit 1.5 mm. long (fig. 83).

Dry plains. Originally described from "dry exposed ridges of Oahu! Lanai! and Maui! Maalaea."

Molokai: Without locality, Rock 8705; Stokes in 1909. Western end, Rock 14005.

Lanai: Miki Plain, Munro 295, Dec. 1916, Jan. 1917.

Maui: Without locality, Faurie 1316.

Without locality: Hillebrand; Mann & Brigham.

14. *Panicum tenuifolium* Hook. & Arn. Bot. Voy. Beechey 101. 1841.

Panicum nephelophilum β var. *tenuifolium* Hillebr. Fl. Haw. Isl. 497. 1888.

Panicum nephelophilum β var. *rhyacophilum* Hillebr. Fl. Haw. Isl. 498, 1888.

Plants perennial; culms erect or sometimes geniculate at base, 30 to 60 cm. tall, sometimes taller, pilose, the nodes villous; sheaths papillose-pilose; ligule a line of hairs 1 to 2 mm. long; blades flat or more or less involute, 10 to 20 cm. long, 2 to 5 mm. wide, pilose; panicle open, oval, 10 to 20 cm. long, 10 to 15 cm. wide, the branches ascending; spikelets 3 mm. long, glabrous, appressed along the branchlets; glumes equal, acute, 5 to 7-nerved; sterile lemma about as long as the glumes, 7-nerved, the palea triangular-acute, half as long as the lemma; fruit 1.7 mm. long (fig. 82).

Dry open ground or open woods. Originally described from "Sandwich Islands." The variety *rhyacophilum* was described from "Hawaii! on lava fields of Laieha, 6000 ft. above the sea (Lydgate), Hualali (M. & B. 327)."¹⁶

¹⁶ The specimen in the Cornell Herbarium is 327; in the National Herbarium and in the Gray Herbarium the number is 237.

Lanai: Munro in 1914.

Maui: Without locality, Hillebrand in 1858.

Hawaii: Kanehaha, Forbes 259; Papaalo, Forbes 313, 315a. Kukaiau Ranch, Hitchcock 14208, 14251, 14256, 14264. Hualalai Mountains, Hitchcock 14518; Mann & Brigham 237.¹⁷ Humuula Sheep Station, Hitchcock 14413; Waimea, Na Puu o Pele, Wilkes. Expl. Exped.

Without locality: Hillebrand.

Dr. Stapf has kindly sent me a portion of the top of *Panicum tenuifolium* Hook. & Arn. collected at "Oahu Bay". The blades are narrow and involute, glabrous on the under or outer surface, densely pubescent and more or less pilose on the upper surface. The plant is described originally as glabrous, the upper surface of the blades not having been investigated. The general aspect and the character of the pubescence place this with the specimens referred by Hillebrand to his variety *rhyacophilum*.

Hillebrand's variety *tenuifolium* is based upon *Panicum tenuifolium* Hook. & Arn. but Hillebrand mentions two other specimens besides the type, as follows, "Molokai! pali of Makonalua; Maui! Haleakala; Oahu (Lay & Collie). In specimens from E. Maui a slight pubescence becomes visible on the nodes of the stems and on the leaf-sheaths". Among the specimens sent by Dr. Stapf there are three from Maui collected by Hillebrand labeled respectively, "Haleakala 538", "Makawa E. Maui 64", and "Maui 536". The first one is the common form of his variety *rhyacophilum* which I am referring to *Panicum tenuifolium* Hook. & Arn. The second and third appear to be the same form and may be duplicates. Some of the blades are flat, glabrous, and as much as 5 mm. wide, other blades are involute and finely pubescent. The plants are caespitose, 25 to 30 cm. tall. These may be the specimens referred to by Hillebrand as having a slight pubescence. The Haleakala specimen is so evidently pubescent as to appear to be excluded from this reference. Hillebrand's Molokai specimen was kindly sent me from the Berlin Herbarium by Dr. Diels. This has glabrous blades as much as 5 or 6 mm. wide, flat below and involute above. I have referred this to *P. nephelophilum* as a small form. Possibly these intermediate specimens constitute a distinct species. This can be determined only by more material.

A specimen in the herbarium of Cornell University, without data, is labeled *Panicum nephelophilum* Gaud. *P. tenuifolium* Hook. & Arn. and bears the note "[revised 1885 by Dr. W. Hillebrand]." The blades are narrow and velvety with a fine hirsutulous pubescence.

15. ***Panicum issachnoides*** Munro; Hillebr. Fl. Haw. Isl. 501. 1888.

Panicum conchoideum Hillebr. as synonym under *P. issachnoides*.

Plants perennial, forming dense tussocks as much as 20 or 30 cm. or more in diameter, repeatedly branching, the lower parts of the culms dying and the new shoots appearing at the periphery; culms indefinite in length but the new shoots only a few centimeters long, the leaves closely imbricate; sheaths striate, more or less pubescent, mostly hidden by the imbricate blades; ligule a very short ciliate membrane 0.5 mm. long; blades horizontally spreading 1 to 3 cm. long, 5 to 7 mm. wide, conspicuously papillose-ciliate, flat and firm, oblong-lanceolate, conchoid or spoon-shaped, striate, clasping at base; panicle narrow and few-flowered, 1 to 2 cm. long.

the few branches appressed; spikelets oblong, 2 mm. long, glabrous; first glume one-fourth to one-third as long as spikelet; second glume and sterile lemma equal or the glume a little shorter, 7 to 9-nerved, the sterile palea about one-third as long as the lemma; fruit 2 mm. long, acute (fig. 85).

Open bogs on mountain summits. Originally described from the "swampy summit of Mt. Eeka, Maui."

Kauai: Summit of Waialeale, Rock; Hitchcock 15504, 15505. Kauluwehi bog near Kaholuamano, Hitchcock 15518.

Molokai: Kawela bog, Forbes 190.

Maui: Puu Kukui, West Maui, Hitchcock 14733. Without locality, Wilkes Expl. Exped.



FIGURE 84.—*Panicum imbricatum*.
From Forbes 879, Kauai.



FIGURE 85.—*Panicum isachnoides*.
From Hitchcock 15518, Kauai.

16. *Panicum imbricatum* Hillebr. Fl. Haw. Isl. 501. 1888.

Plants perennial, forming tussocks 20 to 30 cm. or more in diameter, repeatedly branching, the old stems dying and new shoots forming at the periphery; culms indefinite in length, the new shoots less than 10 cm. long, the leaves closely imbricate; sheaths glabrous or somewhat hispid, striate; ligule less than 1 mm. long, ciliate; blades stiff and firm, spreading, 1 to 1.5 cm. long, 2 to 4 mm. wide, scaberulous on the margin or sometimes ciliate near the base, flat or becoming more or less involute; panicle narrow, few-flowered, 1 to 2 cm. long, the few branches appressed; spikelets 2 mm. long or a little less, oblong-elliptic, glabrous; first glume one-third as long as spikelet; second glume and sterile lemma about equal or the glume a little shorter, 7-nerved, the palea half as long as the lemma; fruit a little less than 2 mm. long (fig. 84).

Forming tussocks in open bogs at the summit of mountains. Originally described from the "swampy summit of Mt. Eeka, Maui."

Kauai: Near Kaholuamano, Forbes 401. Alakai bog, Forbes 879. Waialeale, Rock 5644; Forbes 402; Rock in 1911.

Oahu: Koolauloa Mountains, between Punaluu and Kaipapau, northern part of island, Forbes in 1909.

Molokai: Kawela bog, Forbes 191; Rock; Hitchcock 15195; Forbes 15.

Maui: Puu Kukui, West Maui, Hitchcock 14732, 15505½; summit of Eeka, Forbes 390; Rock.



FIGURE 86.—*Panicum lanaiense*. From Munro
in 1916, Lanai.



FIGURE 87.—*Panicum hillebrandianum*. From
Hitchcock 14731, Maui.

17. *Panicum hillebrandianum* nom. nov.

Panicum monticola Hillebr. Fl. Haw. Isl. 500. 1888. Not *Panicum monticulum* Hook. f. 1864.

Plants perennial; culms erect, 10 to 20 cm. tall, rather stout; sheaths villous, pilose on the collar, longer than the internodes; ligule densely ciliate, about 2 mm. long; blades somewhat coriaceous, flat, ascending, striate, 3 to 6 cm. long, 6 to 7 mm. wide, more or less villous on the margins, otherwise glabrous; panicle about 5 cm. long, the branches ascending; spikelets 3 mm. long, oblong, glabrous; first glume scarcely 1 mm. long; second glume and sterile lemma equal, the glume 7-nerved, the lemma 9-nerved, the sterile palea oval, less than 1 mm. long; fruit about 2 mm. long (fig. 87).

Open mountain bogs. Originally described from the "swamps on the summit of Mt. Eeka, Maui."

Maui: Open bog at summit of Puu Kukui, Hitchcock 14731. Top of mountain of West Maui, Mann & Brigham 435 (Gray Herbarium).

Hawaii: Puu Oo, Forbes 811.



FIGURE 88.—*Panicum forbesii*.
From the type specimen.



FIGURE 89.—*Panicum cynodon*.
From Hitchcock 15503, Kauai.



FIGURE 91.—*Isachne pallens*. From Forbes 1603, Oahu.



FIGURE 90.—*Sacciolepis contracta*. From Hitchcock 14615, Hawaii.

18. *Panicum forbesii* sp. nov.

Plants perennial, in large tufts; culms radiating or erect, 5 to 30 cm. tall; sheaths glabrous or hispidulous; ligule densely ciliate, about 0.5 mm. long; blades flat, spreading, 2 to 5 cm. long, 1 to 3 mm. wide, glabrous; panicle oval, rather few-flowered, 2 or 3 cm. long, the branches ascending or somewhat spreading, 1 cm. long, rather sparsely villous, flexuous; spikelets a little over 2 mm. long, glabrous; first glume less than 1 mm. long; second glume and sterile lemma equal, the glume 9-nerved, the lemma 7-nerved, the sterile palea more than half as long as the lemma; fruit as long as the sterile lemma (fig. 88).

Type in the U. S. National Herbarium, no. 1038972, collected on the banks of Kawaikoi and Waiakoali streams, in the Waimea drainage basin, Kauai, Hawaiian islands, July 3 to August 18, 1917, by C. N. Forbes (no. 1052).

The only other specimen seen is from the Alakai Swamp, also in the Waimea drainage basin.

19. *Panicum cynodon* Reichardt, Sitzungsab. Akad. Wiss. Math. Naturw. (Wien) 76¹:724. 1878.

Plants perennial; forming mats; culms 10 to 15 cm. long; sheaths glabrous or hispidulous; ligule densely ciliate, less than 1 mm. long; blades flat, puberulous on the upper surface, 1 to 2 cm. long, 2 to 3 mm. wide; panicle narrow, 1 to 2 cm. long, the branches ascending or appressed, glabrous or puberulous; spikelets about 2.5 mm. long, glabrous, oblong; first glume half to two-thirds as long as the spikelet; second glume and sterile lemma equal, 7-nerved, the sterile palea half as long as the lemma; fruit 1.5 mm. long (fig. 89).

Open bogs and swampy woods on summits of mountains, forming mats. In the open the culms are short, among other plants the culms are 20-25 cm. tall. Kauai: Kauluwehi Swamp, Hitchcock 15517. Waialeale, 3600-5080 ft., Hitchcock 15503.

37. *SACCIOLEPIS* Nash.

Spikelets oblong-conic; first glume generally much shorter than the spikelet; second glume broad, inflated-saccate, strongly many-nerved; sterile lemma narrower, flat, fewer nerved, its palea nearly as long, often subtending a staminate flower; fertile lemma stipitate, elliptic, chartaceous-indurate, the margins inrolled, the palea not inclosed at the summit. Annuals or perennials, of wet soil, usually branching, the inflorescence a dense, spikelike panicle, commonly elongate.

1. *Sacciolepis contracta* (Wight & Arn.).

Panicum contractum Wight & Arn.; Steud. Syn. Pl. Glum. 1:84. 1854.

Plants annual, glabrous throughout; culms erect from a spreading and branching base, 30 to 60 cm. tall or even as much as 1 meter; blades flat, 5 to 10 cm. long, 3 to 6 mm. wide; panicle spikelike, 4 to 8 cm. long, about 5 mm. thick; spikelets 2.5 to 3 mm. long, rather sparsely hispidulous on the upper half, the terete glabrous pedicels 1 to 2 mm. long; first glume broad, nearly half as long as the spikelet, several-nerved; second glume and sterile lemma equal (fig. 90).

A weed in moist fields; introduced. Originally described from the East Indies.

Mauai: Haiku, Hitchcock 14887. Olinda, Hitchcock 14910.

Hawaii: Glenwood, Hitchcock 14602, 14615.

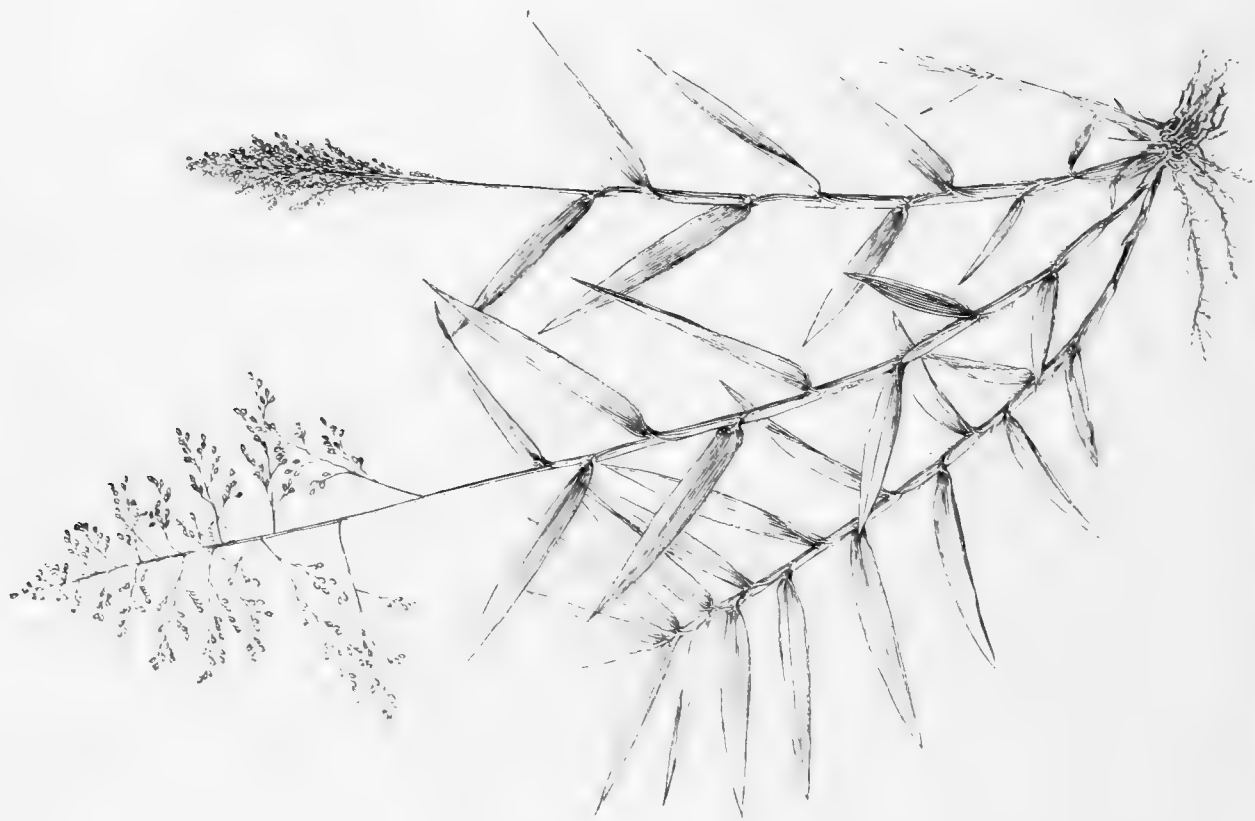


FIGURE 92.—*Isachne distichophylla*. From Hitchcock 14598, Hawaii.



FIGURE 93.—*Opismenus hirtellus*. From Hitchcock 14035, Oahu.

38. **ISACHNE** R. Br.

Spikelets obovoid to subglobose. Glumes membranaceous, about equal and as long as the fruits or at maturity exceeded by them. Lower floret perfect or staminate, its lemma and palea indurate and similar in form and texture to those of the upper floret. Both florets (or fruits) plano-convex, obtuse, equal in size or the upper shorter, the pair usually remaining attached by the minute rachilla joint between them.¹⁷ Perennial or rarely annual grasses with simple or usually branching stems, flat, strongly nerved blades, and paniculate inflorescence.

Fertile florets strongly villous.....1. **I. pallens**.
Fertile florets nearly glabrous.....2. **I. distichophylla**.

1. **Isachne pallens** Hillebr. Fl. Haw. Isl. 504. 1888.

Plants perennial, glabrous; culms rather lax, decumbent, 30 to 60 cm. tall; blades mostly 3 to 10 cm. long and 5 to 7 mm. wide, firm; panicle ovoid, 3 to 8 cm. long, 2 to 3 cm. wide; spikelets 2 mm. long, elliptic; fertile florets elliptic, strongly villous all over with a crisp pubescence (fig. 91).

Damp forests. Originally described from "Woods of the eastern division of Oahu."

Kauai: Between Kawaikoi and Waiokooli, Forbes 1055. Along Hanapepe River, near the falls, Heller 2489.

Oahu: Nuuanu Valley, Forbes 1603; Koolauloa Mountains, Forbes in 1909. Waiahole Valley, Rock 17326; without locality, Forbes in 1907.

2. **Isachne distichophylla** Munro; Hillebr. Fl. Haw. Isl. 504. 1888.

Plants perennial, glabrous; culms rather stout, 50 to 100 cm. tall; blades stiff and firm, lanceolate, flat, mostly 8 to 15 cm. long, 1 to 2 cm. wide; panicle oval or elliptic, 10 to 15 cm. long, 6 to 8 cm. wide; spikelets ovoid, a little less than 2 mm. long, the glumes rather faintly nerved; fertile florets glabrous except for a few hairs at the base and along the margins (fig. 92).

Moist woods. Originally described from the Hawaiian islands. "In the forests of all islands! at altitudes of 2000-3000 ft.; but not common."

Oahu: Without locality, Forbes 1845; Mann & Brigham 213. Behind Honolulu, Wilkes Expl. Exped.

Molokai: Wailau Valley, Forbes 558; without locality, Forbes 236.

Lanai: Upper part of mountain, Hitchcock 14642; Forbes 256; Munro 346, 364.

Maui: Mt. Eeke, Forbes 358.

Hawaii: Alakalei, Rock 4135; Kilauea, Rock; Hitchcock 14598. Papaaloa, Forbes 412; Waimea, Hitchcock 14395; Koolapuuwale, Forbes 277. Na Puu o Pele, Wilkes Expl. Exped. (Gray Herbarium). Without locality, Forbes 710.

39. **OPLISMENUS** Beauv.

Spikelets terete or somewhat laterally compressed, subsessile, solitary or in pairs, in two rows crowded or approximate on one side of a narrow scabrous or hairy rachis; glumes about equal, emarginate or 2-lobed, awned from between the lobes; sterile lemma exceeding the glumes and fruit, notched or entire, mucronate or short-awned, inclosing a hyaline palea; fertile lemma elliptic, acute, convex or boat-shaped, the firm margins clasping the palea, not inrolled. Freely

¹⁷ For further discussion see Chase, Agnes, Genera Paniceae IV: Proc. Biol. Soc. Washington, Vol. 24, p. 149, 1911.

branching, creeping, shade-loving annuals or perennials, with erect flowering shoots, flat, thin lanceolate or ovate blades, and several one-sided, thickish, short spikes rather distant on a main axis.

1. **Oplismenus hirtellus** (L.) Beauv. Ess. Agrost. 54, 168. 1812.

Panicum hirtellum L. Syst. Nat. ed. 10. 2:870. 1759.

Plants perennial, branching, creeping and rooting, the fertile culms ascending, 20 to 40 cm. long, glabrous; sheaths glabrous or appressed pubescent, villous on the margin, the surface in some plants hirsute; blades lanceolate, acuminate, commonly somewhat asymmetric at base, 5 to 10 cm. long, 8 to 17 mm. wide, thin, more or less hispid on upper surface, hispid or glabrous beneath; panicle mostly 7 to 15 cm. long, the axis scabrous, or hispidulous above, sometimes pilose-hispid on the angles above; racemes several, ascending or appressed, the lowermost distant, 2 to 4 cm. long, the others successively shorter and closer together, the rachis hispidulous at base and with long stiff whitish hairs, above the base scabrous and hispidulous with here and there long stiff hairs intermixed; spikelets approximate, more or less clustered along the rachis; first and second glumes about two-thirds as long as the spikelet, more or less appressed-hispidulous, 3 to 5-nerved, slightly truncate or emarginate at the apex, extending into a smooth terete purplish awn, the first 5 to 10 mm. long, the second reaching about to the end of the spikelet; sterile lemma broad, several-nerved, hispidulous like the glumes, apiculate or short-awned, 3 to 4 mm. long, the palea narrow, more than half as long as the lemma, sometimes inclosing stamens; fruit about 2.5 mm. long (fig. 93).

Hillebrand refers the Hawaiian species to *O. compositus sylvaticus* and cites as a synonym *O. oahuensis* Nees. The latter is a *nomen nudum*. It was listed by Steudel¹⁸ as a synonym of *Panicum oahuense* (Steud. Ins. Oahua) which also is a *nomen nudum*.

This species differs from *O. compositus* (L.) Beauv. in the shorter racemes with more compactly arranged spikelets. It may have been introduced into the Hawaiian islands from tropical America where it is common.

Rain forest and shady slopes. Originally described from Jamaica.

Kauai: Wailua Falls, Forbes 495, 497.

Oahu: Mountains east of Schofield Barracks, Hitchcock 14035; Nuuanu Pali, Hitchcock 13776, 14057; Waialae Valley, Forbes 1951. Valley behind Honolulu, collector unknown, probably Wilkes Expl. Exped. Tantalus, Heller 2061. Kaala Mountains, Wilkes Expl. Exped. (Gray Herbarium). Without locality, Hillebrand 484; Mann & Brigham 20; Seeman 2248 (Gray Herbarium).

Molokai: Pukoo, Hitchcock 15041.

Maui: Lahaina, Hitchcock 14878, 14879.

Hawaii: Honaunau, Hitchcock 14544. Puu Waawaa, Hitchcock 14479. Hilo, Hitchcock 14199; Newell in 1917. Without locality, Remy 104 (Gray Herbarium).

40. **ECHINOCHLOA** Beauv.

Spikelets plano-convex, often stiffly hispid, subsessile, solitary or in irregular clusters on one side of the panicle branches; first glume about half the length of the spikelet, pointed; second glume and sterile lemma equal, pointed, mucronate, or the glume short-awned and the lemma long-awned, in some species conspicuously so, inclosing a membranaceous palea and in some species a staminate flower; fertile lemma plano-convex, smooth and shining, acuminate-pointed, the

¹⁸ Steudel, Ernst G., Nomenclator botanicus, 2d ed., Vol. 2, p. 260, 1841.

margins inrolled below, flat above, the apex of the palea not inclosed. Coarse, often succulent, annual or perennial, grasses, with compressed sheaths, linear flat blades, and rather compact panicles composed of short, densely flowered racemes along a main axis.

Racemes without stiff hairs at base, simple, rather distant, 1 to 2 cm. long; spikelets crowded in about 4 rows, the awn of the sterile lemma reduced to a short point; blades 3 to 6 mm. wide 1. ***E. colonum***.

Racemes hispid at base with long stiff hairs, more or less branched, commonly more than 2 cm. long; spikelets irregularly crowded and fascicled, not arranged in rows, the awn of the sterile lemma more or less developed; blades commonly more than 5 mm. wide..... 2. ***E. crusgalli crus-pavonis***.

1. ***Echinochloa colonum*** (L.) Link, Hort. Berol. 2:209. 1833.

Panicum colonum L. Syst. Nat. ed. 10. 2:870. 1759.

Plants annual; culms prostrate-spreading, ascending, or erect, commonly 20 to 40 cm. long, glabrous, compressed; sheaths glabrous, compressed; ligule wanting; blades rather lax, 5 to 10 cm. long, rarely longer, 3 to 6 mm. or rarely as much as 1 cm. wide, somewhat scabrous on the margins, occasionally with transverse purple bands (zonate); panicles 5 to 10 or even 15 cm. long, the axis smooth or slightly scabrous; racemes several, 1 to 2 cm. long or rarely longer, appressed or ascending, single or two approximate, the lower ordinarily distant as much as 1 cm., the rachis triangular-flattened, scabrous; spikelets about 3 mm. long, crowded, nearly sessile, in about 4 rows; second glume and sterile lemma short-pointed but not awned; fruit about 2.5 mm. long, short-pointed (fig. 94).

Along streets and in fields; introduced. Originally described from India. Oahu: Honolulu, Hitchcock 13709, 13746; Munro 7. Waialua Mountains, Mann & Brigham 268. Makiki, Heller 1978.

Hawaii: Hilo, Newell in 1917.

2. ***Echinochloa crusgalli crus-pavonis*** (H. B. K.) Hitchc. Contr. U. S. Nat. Herb. 22:148. 1920.

Oplismenus crus-pavonis H. B. K. Nov. Gen. & Sp. 1:108. 1816.

Plants annual; culms erect or sometimes decumbent at base, as much as 1 meter or even 1.5 meters tall, glabrous; sheaths glabrous; ligule wanting, the ligular area sometimes slightly pubescent; blades 2 to 8 mm. wide, sometimes wider, scabrous on the margins, sometimes on the upper surface; panicles nodding, rather soft, 10 to 20 cm. long, the axis scabrous; racemes mostly ascending or appressed, the lower somewhat distant, as much as 10 cm. long but as a rule shorter, commonly unbranched, the upper approximate, shorter, the rachis scabrous, hispid, especially at the base; spikelets crowded, about 2.5 mm. long, excluding the awns, strongly hispid or papillose-hispid on the nerves, hispidulous on the internerves; sterile lemma with a well-developed palea, neuter, the awn variable in length, mostly 5 to 10 mm. long, on at least a part of the spikelets, sometimes as much as 3 cm. long; fruit elliptic, turgid, narrowed into a cusp or point, about 2 mm. long, whitish or brownish (fig. 95).

This variety of the cosmopolitan *E. crusgalli* is common in tropical America. It differs from the species itself in having nodding rather soft panicles, the spikelets averaging smaller, less strongly hispid, the awn variable in length, but as a rule not over 1 cm. long. Awned and awnless or partially awnless panicles may occur on the same plant. In some plants only the spikelets near the end of the raceme are awned. In Hitchcock's 14462, Waimea, Hawaii, the sterile lemmas are indurate like the fertile. This specimen has awnless, rather larger spikelets, and possibly might better be referred to *E. crusgalli zelayensis* (H. B. K.) Hitchc. of Mexico.

Along ditches and especially in rice fields; introduced. Originally described from Venezuela.

Kauai: Hihi Mountains, Forbes 630. Lihue, Forbes 478, 480.

Oahu: Waikiki, Hitchcock 13800. Waialua, Rock in 1912. Kalihi Valley, Hitchcock 14101, 14117, 14119. Upper Manoa Valley, Hitchcock 13736. Fort Shafter, Hitchcock 13846. Kaneohe, Hitchcock 13900, 13901. Schofield Barracks, Hitchcock 14031. Lower Pauoa, Heller 2384, 2384a. Without locality, Mann & Brigham 24.

Molokai: Kamalo Bog, Hitchcock 15105. Pukoo, Hitchcock 15110.

Hawaii: Hilo, Hitchcock 14151, 14181; Newell in 1917. Kukuihaele, Rock 4536. Waimea, Hitchcock 14462.

Without locality: Hillebrand.



FIGURE 94.—*Echinochloa colonum*. From Contr. U. S. Nat. Herb. Vol. 22, fig. 35.



FIGURE 95.—*Echinochloa crus-galli*. From Contr. U. S. Nat. Herb. Vol. 22, fig. 34.



FIGURE 96.—*Chaetochloa verticillata*. From Contr. U. S. Nat. Herb. Vol. 22, fig. 43.

41. *TRICHOLAENA* Schrad.

Spikelets on short capillary pedicels; first glume small, much shorter than the spikelet, villous; second glume and sterile lemma equal, raised on a stipe above the first glume, emarginate or slightly lobed, short-awned, covered, except toward the apex, with long silky hairs, the palea of the sterile lemma well developed; fertile lemma shorter than the spikelet, cartilaginous, smooth, boat-shaped, obtuse, the margins thin, not inrolled, inclosing the margins of the palea. Perennial or annual grasses, with rather open panicles of silky spikelets.

1. *Tricholaena rosea* Nees, "Cat. Sem. Hort. Vratisl. a. 1836"; Fl. Afr. Austr. 17. 1841. NATAL GRASS.

Plants perennial; culms slender, erect from a normally decumbent base, about 1 meter tall; sheaths glabrous, or the lowermost appressed-hispid, puberulent on the collar; ligule densely ciliate, about 1 mm. long; blades flat, 5 to 10 cm. long, 2 to 5 mm. wide, glabrous, or sometimes pilose about the base; panicle ovoid, purple or tawny, 7 to 15 cm. long, the branches slender, scabrous, the pedicels capillary, flexuous; spikelets about 3 mm. long, the silky hairs 2 to 3 mm. long (fig. 98).

This species is a good forage grass and has been grown successfully on Hawaii and Molokai. It thrives in loose or sandy soil at medium altitudes in the drier regions. A fine field of this was observed on Mr. George Cooke's ranch, Molokai.

Grassland and along roadsides; introduced, abundantly naturalized in Molokai and Hawaii. Originally described from South Africa.

Kauai: Hanamaulu, Faurie 1354.

Oahu: Kaimuki, Forbes 1938. Schofield Barracks, Hitchcock 13980.

Molokai: Western part, Hitchcock 15150. Kaunakakai Gulch, Forbes 625.

Hawaii: Kukuihaele, Rock 4511. Kukaiau Ranch, Hitchcock 14206.

42. **CHAETOCHLOA** Scribn.

(*Setaria* Beauv.)

Spikelets subtended by one to several bristles (sterile branchlets), falling free from the bristles, awnless; first glume broad, commonly less than half the length of the spikelets, 3 to 5 nerved; second glume and sterile lemma equal, or the former shorter, several-nerved; fertile lemma coriaceous indurate, smooth or rugose. Annual or perennial grasses, with narrow terminal panicles, these dense and spikelike, or somewhat loose and open.

Blades narrowly elliptic, as much as 9 cm. wide, plaited; bristles below only a part of the spikelets; panicles loose and open.....1. **C. palmifolia.**

Blades linear-lanceolate to linear, mostly not over 1 cm. wide; bristles below all the spikelets; panicle spikelike, cylindric.

Bristles below each spikelet 1 to 3, retrorsely scabrous.....2. **C. verticillata.**

Bristles below each spikelet more than 5, antrorsely scabrous.

Plants annual.....3. **C. lutescens.**

Plants perennial.....4. **C. geniculata.**

1. **Chaetochloa palmifolia** (Willd.) Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:348. 1917.

Panicum palmifolium Willd.; Poir. in Lam. Encycl. Suppl. 4:282. 1816.

Panicum nervosum Roxb. Fl. Ind. ed. Carey 1:314. 1820. Not *P. nervosum* Lam. 1798.

Panicum neurodes Schult. Mant. 2:228. 1824.

Plants perennial; culms erect, 1 to 2 meters tall, some plants depauperate, more or less appressed-hispid below and at the nodes; sheaths papillose and more or less hispid; blades resembling those of a young palm, narrowly elliptic, as much as 50 cm. long and 9 cm. wide, acuminate, narrowed almost to a petiole, flat, strongly nerved and plicate, scabrous on the upper surface, pubescent beneath; panicle large and open, as much as 60 cm. long, consisting of numerous slender spreading branches as much as 20 cm. long, the spikelets on short appressed branchlets or toward the ends single, the axis and branches very scabrous, the branchlets bearing here and there slender flexuous bristles, about 1 cm. long; spikelets lanceolate, green, glabrous, about 4 mm. long on scabrous pedicels about 1 mm. long; first glume broad, ovate, rather obtuse, 3-nerved, about one-third as long as the spikelet; second glume a little shorter than the fruit, 7-nerved; sterile lemma with a point extending a little beyond the fruit, 5-nerved, the narrow palea about two-thirds as long; fertile lemma lanceolate with a short somewhat incurved point; rather obscurely transversely rugose (fig. 97).

This species belongs to the section *Ptychophyllum*, characterized by the large plicate blades and usually loose panicle with lanceolate fruit and few bristles. The name *Panicum plicatum* Lam. has been applied to this species but an examination of Lamarck's type at Paris showed it to have narrow blades 20 cm. long and 12 mm. wide and a narrow panicle.



FIGURE 97.—*Chaetochloa palmifolia*. From Hitchcock 14076, Oahu.



FIGURE 98.—*Tricholaena rosea*. From U. S. Dept. Agr. Bull. 772, fig. 147.

Damp open woods or moist open ground; introduced. Originally described from India.

Oahu: Mt. Tantalus, near Halfway House, Hitchcock 13877, 14076. Upper Manoa Valley, Hitchcock 13732.

Hawaii: Kukuiahaele, Rock 4519. Hilo, Hitchcock 14148, Newell in 1917.

2. *Chaetochloa verticillata* (L.) Scribn. U. S. Dept. Agr. Div. Agrost. Bull. 4:39. 1897.

Panicum verticillatum L. Sp. Pl. ed. 2. 1:82. 1762.

Setaria verticillata Beauv. Ess. Agrost. 51. 1812.

Plants annual; culms erect or decumbent at base, 30 to 60 cm. tall, or even as much as 1 meter; sheaths keeled, glabrous; blades flat, 5 to 15 cm. long, as much as 1 cm. wide or even more, scabrous; panicle cylindric, dense, 2 to 8 cm. long, 1 cm. wide, somewhat lobed, the crowded branches as much as 1 cm. long, the bristles below each spikelet 3 to 6 mm. long, retrorsely-scabrous; spikelets oval, about 2 mm. long; first glume about one-third as long as the spikelet; second glume slightly shorter than the fruit; sterile lemma as long as the fruit; fertile lemma obscurely transversely rugose (fig. 96).

A weed in fields and waste places; introduced. Originally described from the Old World.

Oahu: Honolulu, Hitchcock 13707, 14065; Newell in 1917. Waikiki, Heller 1961, 2289.

3. *Chaetochloa lutescens* (Weigel) Stuntz, U. S. Dept. Agr. Bur. Pl. Ind. Inv. Seeds 31:36, 86. 1914.

Panicum lutescens Weigel, Obs. Bot. 20. 1772.

Plants annual; culms erect or geniculate below, sometimes prostrate-spreading, rather succulent below, as much as 1 meter tall but usually lower, scabrous below the panicle; sheaths smooth, compressed-keeled; blades as much as 25 cm. long and 1 cm. wide, flat, twisted in a loose spiral, the upper surface along the upper half faced downward, acuminate-pointed, often glaucous, toward the base on the upper surface beset with long lax hairs; panicle dense, evenly cylindric, spikelike, yellow at maturity, mostly 5 to 10 cm. long, about 1 cm. thick, rounded at the summit, the axis densely pubescent, the branches mostly less than 1 mm. long, the cluster of bristles below each spikelet usually more than 5, sometimes 20 or more; bristles antrorsely scabrous, yellow, the longer ones 2 or 3 times as long as the spikelets; spikelets about 3 mm. long, oval; first glume about half, the second about two-thirds as long as the spikelet; sterile lemma equaling the fruit, the palea well developed; fertile floret strongly transversely rugose (fig. 102).

This species has usually been called *Chaetochloa glauca* (L.) Scribn. or *Setaria glauca* Beauv., but the basis of those names, *Panicum glaucum* L., properly applies to the pearl millet (*Pennisetum glaucum* (L.) R. Br.)

A weed in fields; introduced. Originally described from Europe.
Hawaii: Waimea, Hitchcock 14461.

4. *Chaetochloa geniculata* (Lam.) Millsp. & Chase, Field Mus. Bot. 3:37. 1903.

Panicum geniculatum Lam. Encycl. 4:727 (err. typ. 737). 1798.

Setaria purpurascens H. B. K. Nov. Gen. & Sp. 1:110. 1816.

Panicum imberbe Poir. in Lam. Encycl. Suppl. 4:272. 1816.

Plants perennial, producing short knotty branching rhizomes as much as 4 cm. long; culms erect, spreading or prostrate, tufted or solitary, as much as 1 meter tall, the base usually hard and wiry; sheaths keeled; blades flat, scabrous, villous toward the base on the upper surface, mainly straight (not twisted as in *C. lutescens*), as much as 20 cm. long and 8 mm. wide;

panicle as in *C. lutescens*, but rather more slender, yellow, purple, or greenish; bristles mostly 8 to 12 below each spikelet, yellow or purple, 1 to 3 times or even as much as 6 times as long as the spikelets, antrorsely scabrous; spikelets 2 to 2.5 mm. long, otherwise about as in *C. lutescens* (fig. 100).

This species differs from *C. lutescens* in being perennial and in the wiry or less succulent base of the culms.

Grassland and waste places; introduced. Originally described from Guadeloupe.

Kauai: Olokele Gulch, Hitchcock 15249. Hanapepe River, Heller 2469. Without locality, Remy 106 (Gray Herbarium).

Oahu: Nuuanu Pali, Hitchcock 13783, 14054. Nuuanu Valley, Forbes 1523. Mt. Tantalus, Hitchcock 13880, 14077.

Hawaii: Hilo, Newell in 1917.



FIGURE 99.—*Coix lachryma-jobi*. From U. S. Dept. Agr. Bull. 772, fig. 174.



FIGURE 100.—*Chaetochloa geniculata*. From Contr. U. S. Nat. Herb. Vol. 22, fig. 41.

43. **DISSOCHONDRUS** (Hillebr.) Kuntze.

Spikelets subtended by a single persistent bristle (sterile branchlet), awnless, consisting of 2 membranaceous glumes and 2 cartilaginous florets, the 2 fruits similar and closely contiguous by their flat inner faces; first glume broad, about one-fourth as long as the spikelet; second glume a little longer than the 2 florets; lemmas cartilaginous-indurate, smooth, nerveless, the margins inrolled over the cartilaginous palea, the 2 fruits similar, the lower a little longer but rising to the same height. Rather tall perennial grasses with flat petioled blades, auriculate sheaths and slender spikelike panicles.

The genus is based on *Setaria biflora* Hillebr., the only species, and was first described as a subgenus of *Setaria* by Hillebrand.¹⁹ Kuntze²⁰ raised this subgenus to generic rank but inadvertently gave the species as "*Dissochondrus bifidus* OK. = *Setaria bifida* Hillebr."

1. **Dissochondrus biflorus** (Hillebr.) Kuntze; Hack. in Engl. & Prantl, Pflanzenfam. 1: Nachtr. 41. 1897.

Setaria biflora Hillebr. Fl. Haw. Isl. 503. 1888.

Culms 60 to 120 cm. tall, compressed, puberulent at the nodes; sheaths glabrous, compressed-keeled, extending at the summit beside the petiole into 2 membranaceous, more or less deciduous or fragile auricles as much as 4 cm. long, especially prominent on the innovations; ligule short, scarious; blades flat, firm, 15 to 30 cm. long, 1 to 2 cm. wide, gradually acuminate, contracted at base into a petiole, glabrous, scaberulous on the margin and toward the tip; panicle cylindric, slender, spikelike, 10 to 20 cm. long, somewhat loosely flowered, more or less interrupted at base, the branches short and appressed, the axis puberulent; bristles flexuous, antrorsely scabrous, 5 to 10 mm. long, solitary below each spikelet or wanting below some of the spikelets; spikelets 2.5 to 3 mm. long, pointed, glabrous; first glume broad, obtuse, one-fourth to one-third as long as the florets, puberulent, scarcely nerved; second glume pointed beyond the florets, puberulent, faintly 5-nerved; florets yellowish, smooth and polished, about 2 mm. long, slightly pointed, the tip minutely puberulent (fig. 101).

Rocky slopes in partial shade. Originally described from Lanai.

Oahu: West of Schofield Barracks, Hitchcock 13952. Makaleha Ridge, Rock 17081.

Molokai: Puu Kolekole, Forbes 219.

Pennisetum macrostachyum (Brong.) Trin. was found near a garden, Hilo, where the species was cultivated for ornament (Hitchcock 14175). It is a tall graceful perennial with flat blades 1.5 to 2.5 cm. wide, and a feathery purplish panicle 15 to 20 cm. long, the numerous bristles 2 to 3 cm. long.

44. **CENCHRUS** L.

Spikelets solitary or few together, surrounded and inclosed by a spiny bur composed of numerous coalescing bristles (compound sterile branchlets), the burs sessile or nearly so, falling with the spikelets and permanently inclosing them, the seed germinating within the old involucre, the spines usually retrorsely barbed. Annual or perennial, commonly low branching grasses, with flat blades and racemes of burs, the burs readily deciduous.

Plants perennial; burs fusiform..... 1. **C. agrimonioides.**

Plants annual; burs globular.....

Foliage glabrous..... 2. **C. echinatus.**

Foliage pubescent..... 3. **C. hillebrandianus.**

¹⁹ Op. cit., p. 503. 1888.

²⁰ Kuntze, Otto., Revisio generum plantarum, Vol. 2, p. 770, Stuttgart & Tubingen, 1891.

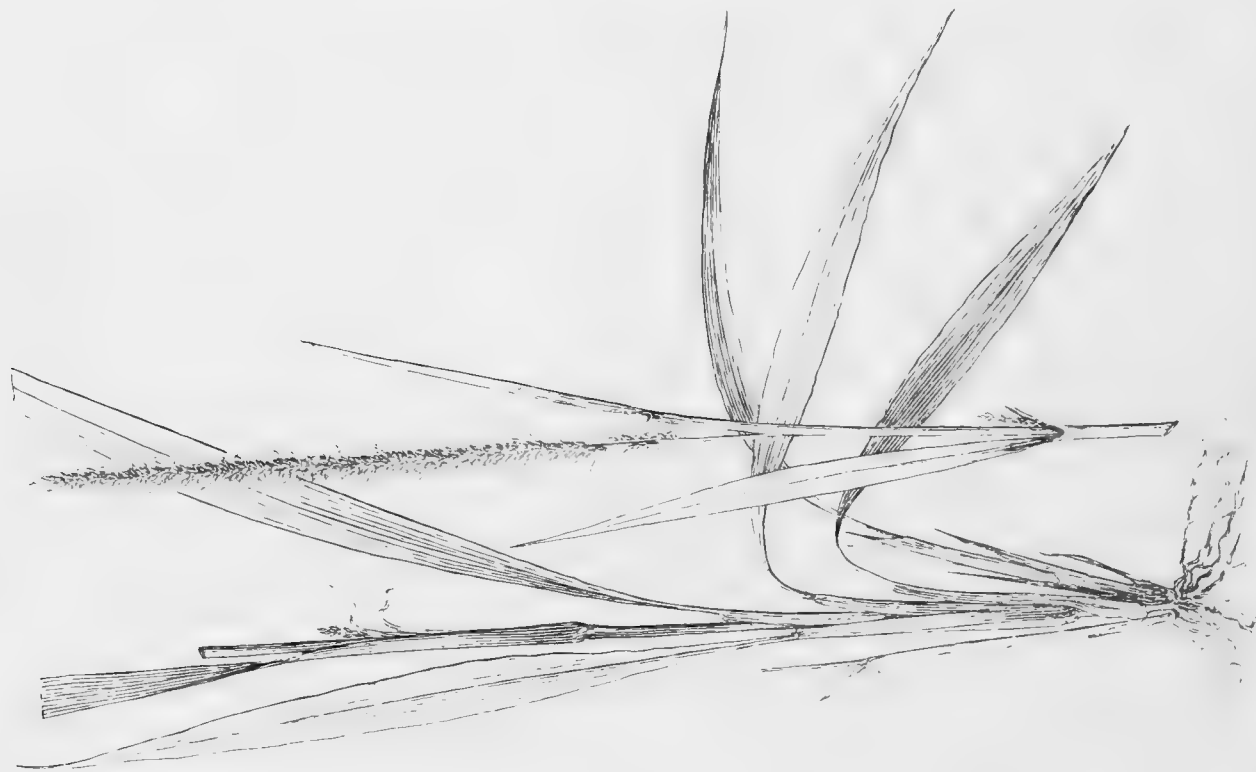


FIGURE 101.—*Dissolochloa villorus*. From Hitchcock 13952, Oahu.

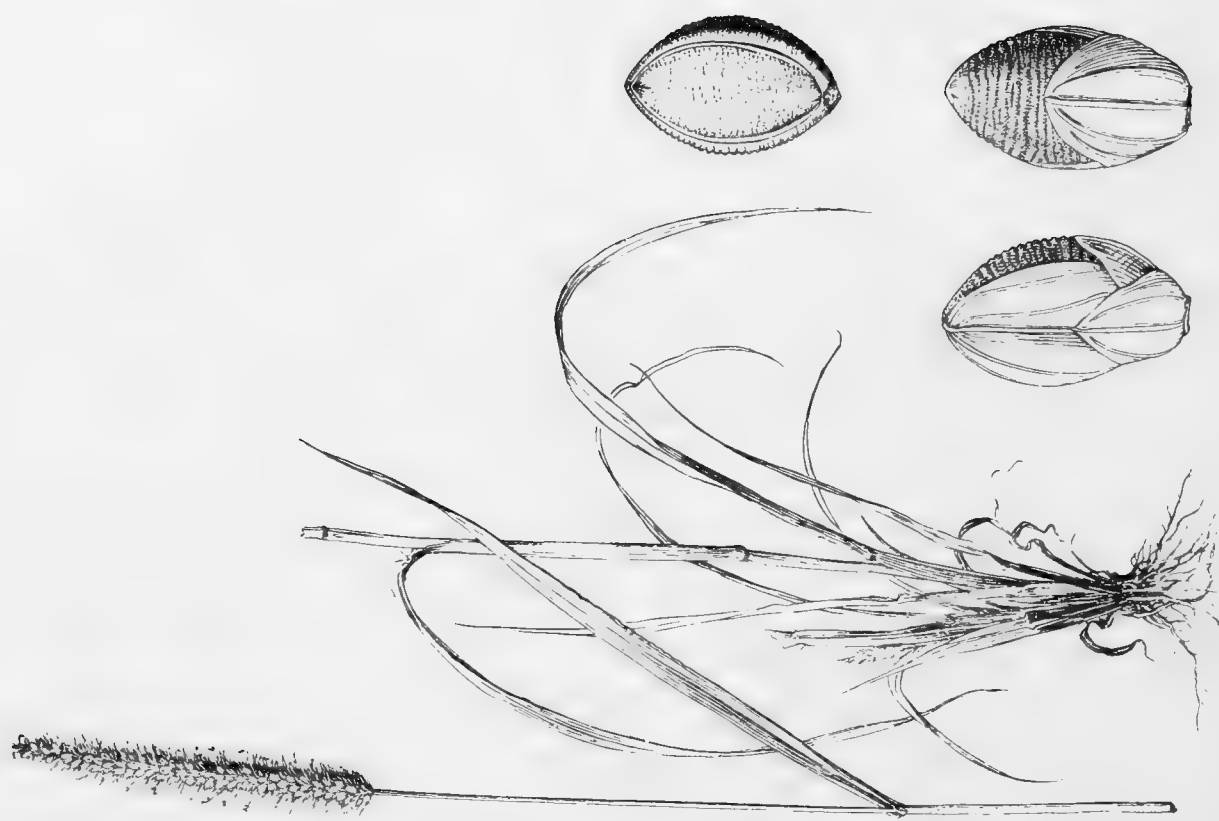


FIGURE 102.—*Chaetochloa lutescens*. From Contr. U. S. Nat. Herb. Vol. 22, fig. 40.

1. *Cenchrus agrimonioides* Trin. Gram. Pan. 72. 1826.

Cenchrus calyculatus uniflorus Hillebr. Fl. Haw. Isl. 505. 1888.

Plants perennial, very leafy; culms glabrous, scabrous below the panicle, robust, swollen at the nodes, 30 to 60 cm. tall, the internodes short; sheaths compressed-keeled, much longer than the internodes, glabrous; blades flat or folded, 15 to 30 cm. long, 4 to 8 mm. wide, glabrous beneath, scabrous on the upper surface; racemes 5 to 10 cm. long, the axis densely puberulent; burs approximate, mostly somewhat reflexed at maturity, fusiform, about 1 cm. long, the base narrow below, expanding above, 2 to 3 mm. long, densely pubescent; basal series of bristles numerous, more or less spreading, 2 to 3 mm. long, retrorsely scabrous, the larger ones tomentulose at base; body of bur cleft only one-third to scarcely one-half its length, lobes erect, appressed, forming an irregular beak, densely tomentose along the middle part, the apex retrorsely scabrous; spikelets 1 in each bur (fig. 104).

The Laysan specimens have somewhat larger burs and flat blades 15 to 20 cm. long and 1 to 2 cm. wide, and the base of the bur is more abruptly enlarged upward. These may represent a distinct species. The specimens are said to be 3 or 4 feet tall.

Originally described from the Hawaiian islands.

Laysan: Bryan 8729; Snyder in 1902.

Oahu: Without locality, Wilder in 1912.

Lanai: Munro 404.

Maui: Auwahi, Rock. East Maui, Wilkes Expl. Exped.

Without locality: Hillebrand; Wawra.

2. *Cenchrus echinatus* L. Sp. Pl. 1050. 1753.

Plants annual; culms much branched, decumbent at base, 30 to 50 cm. tall, scabrous below the inflorescence; sheaths glabrous; blades flat, 5 to 10 cm. long, about 5 mm. wide, glabrous beneath, scabrous on the upper surface; racemes 3 to 5 cm. long; the axis scabrous on the angles, the burs rather loosely arranged, barely touching each other; burs globular, about 5 mm. wide, the obconical base about 1 mm. long, tomentulose, the basal series of bristles 2 to 3 mm. long, the inner series flattened, ascending or the innermost connivent below the middle, tomentose except the apex; spikelets usually 3 or 4 in each bur (fig. 103).

Weed in fields; introduced. Apparently rare in the Hawaiian islands; common in the American tropics. Originally described from Jamaica.

Oahu: Honolulu, Hitchcock 13854.

Hawaii: Hilo, Newell in 1917.

3. *Cenchrus hillebrandianus* sp. nov.

Plants annual, usually much branched and decumbent at base; culms glabrous, 30 to 50 cm. tall; sheaths and blades soft-pubescent or villous, the sheaths mostly longer than the internodes, compressed-keeled; the blades flat, ascending or spreading, mostly 10 to 15 cm. long, 3 to 6 mm. wide; racemes mostly 3 to 6 cm. long, oblong, the axis angled, scabrous and pilose, flexuous, the internodes 2 to 3 mm. or the lower sometimes 5 to 8 mm. long; burs globular, mostly 5 to 6 mm. wide, the base villous, obconical, about 2 mm. long; outer series of spines numerous, irregular in length, the longer about 3 mm. long; inner series stout, flattened below and subulate above, about 5 mm. long, spreading or ascending, or the innermost incurved villous except the tip; spikelets mostly 3 or 4 in each bur, about 6 mm. long; first glume triangular-ovate, broad, about 2 mm. long, 1-nerved; second glume minutely scaberulous, about two-thirds as long as the spikelet, strongly 3-nerved with 2 outer weaker pairs of nerves; sterile lemma acuminate, a little shorter than the fertile, nerved about as the second glume, minutely

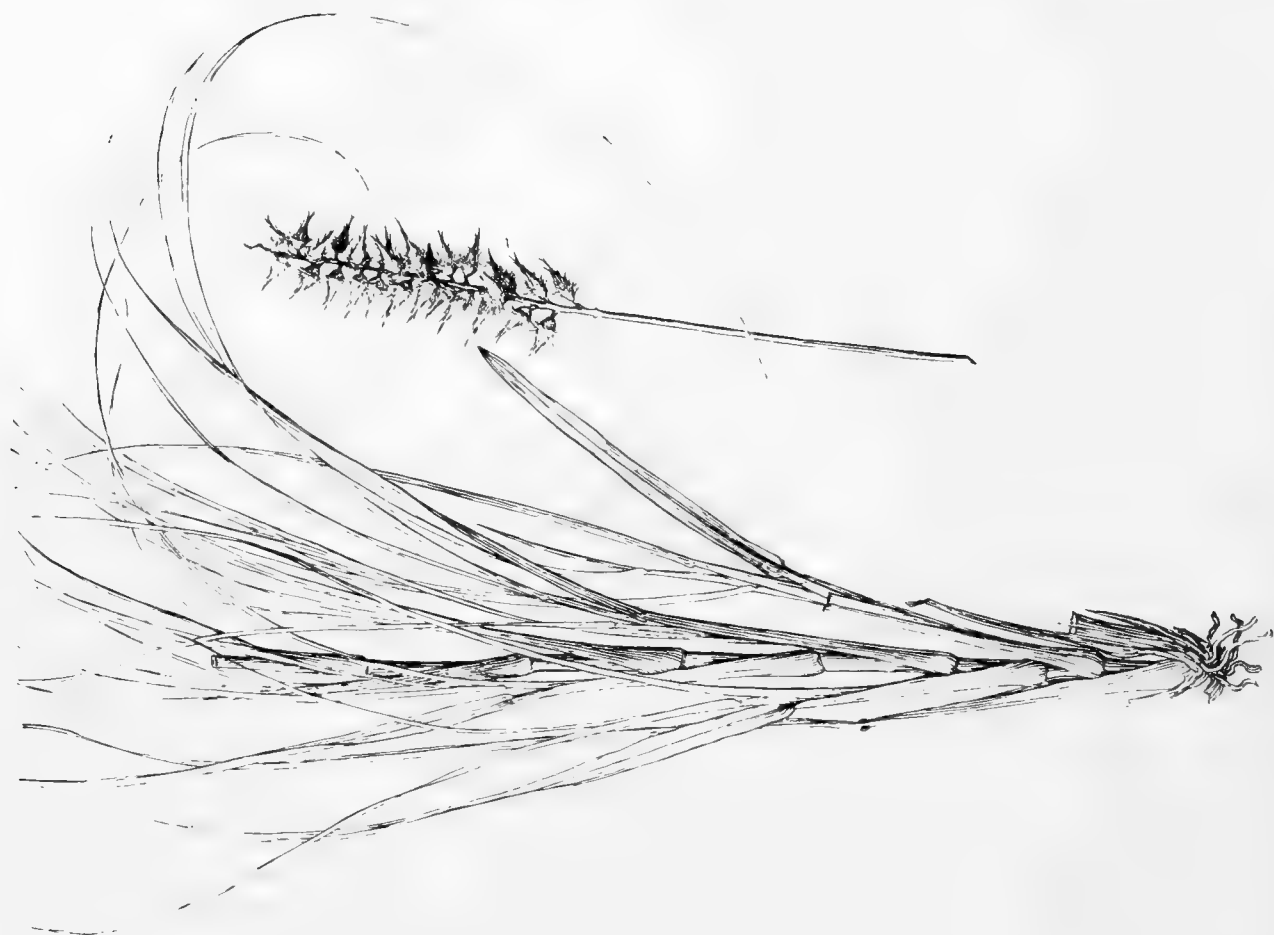


FIGURE 104.—*Cenchrus agrimonoides*. From Snyder in 1902, Laysan.



FIGURE 103.—*Cenchrus echinatus*. From U. S. Dept. Agr. Div. Agrost. Bull. 17, fig. 407.

scaberulous, containing a more strongly scaberulous palea and, sometimes, stamens; fertile lemma acuminate, cartilaginous, smooth below, nerved and scaberulous above; caryopsis oblong-oval, a little compressed, 3 mm. long, about 2 mm. wide (fig. 106).

Type in the U. S. National Herbarium, no. 836482, collected in sandy soil at Waikiki, near Honolulu, Hawaiian islands, June 19, 1916, by A. S. Hitchcock (no. 13801).

Hillebrand²¹ refers this species to *C. echinatus*, but parts of the spikelet, such as the scaberulous sterile palea, are slightly different. *C. hillebrandianus* differs from *C. echinatus* also in the villous or pilose foliage. The species may be the same as *C. laniflorus* Steud.²² from Tahiti, of which I have seen no specimen. The description indicates a much taller plant, having very minute sparse pubescence on sheaths and blades, and a densely lanate axis of the raceme and densely plumose burs.

Besides the Hawaiian specimens there are in the National Herbarium two others, one from Easter Island (Fuentes 9) and one from Tahiti (Moore 220).

A common weed in waste places and cultivated soil; apparently introduced. Oahu: Pass west of Schofield Barracks, Hitchcock 13960. Honolulu, Hitchcock 14068, Forbes 1021. Waikiki, Heller 1964; Hitchcock 13801. Without locality, Mann & Brigham 1. Molokai: Pukoo, Hitchcock 15056. Lanai: West end, Hitchcock 14716. Hawaii: Kau Desert, Forbes 393. Kilauea Crater, Hitchcock 14610.

Sugar Cane (*Saccharum officinarum* L. Sp. 54. 1753) is extensively cultivated in the Hawaiian islands and sometimes persists but does not spread. It is a tall stout grass, 2 to 5 meters tall or even taller, with solid juicy stems, broad flat blades, and large plumelike panicles, 30 to 60 cm. long, with numerous small spikelets about 3 mm. long, each surrounded at the base by a tuft of silky hairs two or three times as long as the spikelet.

45. ISCHAEMUM L.

Spikelets in pairs, along a straight disarticulating rachis, one sessile and perfect, the other pediceled and usually perfect though not always fruitful; fertile lemma of both spikelets awned, the awn usually developed. Annual or perennial grasses with 2, or rarely more, racemes in pairs at the summit of the culms.

1. *Ischaemum byrsonia* (Trin.).

Spodiopogon byrsonia Trin. Mém. Acad. St. Pétersb. VI. Math. Phys. Nat. 2:301. 1832.

Ischaemum lutescens Hack. in DC. Monogr. Phan. 6:221. 1889.

Plants perennial, sending out stolons; culms erect from a decumbent base, glabrous, weakly long-pilose at the nodes, 40 to 80 cm. tall; sheaths glabrous; ligule prominent, 2 to 4 mm. long, truncate, membranaceous in the center, coalescing at the margins with firm auricles extending up from the sheath; blades flat, tapering to a fine point, 10 to 20 cm. long, 3 to 5 mm. wide, glabrous, the uppermost much reduced; racemes 2, digitate, tawny or yellowish, 4 to 10 cm. long, the rachis joints pilose at the base and along the margins toward the top, triangular, about 4 mm. long, 1 mm. thick, cupshaped at summit; sessile spikelet about 7 mm. long, exclud-

²¹ Op. cit., p. 506.

²² Steudel, Ernst G., Synopsis plantarum glumacearum, Vol. 1, p. 110, Stuttgart, 1854.



FIGURE 105.—*Cenchrus hillebrandianus*. From the type specimen.



FIGURE 106.—*Andropogon saccharoides*. From U. S. Dept. Agr. Bull. 772, fig. 161.

ing awns, the hairs at base about half as long; first glume oblong, flat on the back, acute, scaberulous, pilose on the back with several long hairs, the apex bidentate, the teeth short-awned; second glume keeled, scaberulous toward the tip, about as long as the first, tapering into an awn 5 mm. long; sterile lemma hyaline, about as long as the first glume; fertile lemma hyaline, bidentate, between the teeth extending into an awn 2 cm. long, tightly twisted to the first bend (about 5 mm.); pediceled spikelet about 5 mm. long, the pedicel about 3 mm. long, thick and triangular like the rachis joint, long-pilose on one angle, ciliate on the other angles; glumes similar to those of the sessile spikelet, the first more distinctly nerved, the second shorter-awned; awn of fertile lemma shorter than that of sessile spikelet (fig. 109).

Open rocky places. Originally described from "O-Wyhee (inss. Sandwich—in sinu Byronis 11)." Hackel,²³ who received from Maximowicz an authentic specimen, states that it does not well agree with Trinius's description. He therefore describes the species anew. In the Gray Herbarium is a specimen of this species from "Herb. Soc. Hort. Lond." collected on "Ins. Owhyhee, ad sinum Byron" by Macrae. Macrae visited the Hawaiian Islands about 1825, having been sent out on an expedition by the Horticultural Society of London. Trinius's description applies to our plant fairly well, except that he gives the number of spikes as 3 or 4 and states that the nodes are glabrous and the first glume 11 to 13-nerved. There are also slight discrepancies in some of the measurements, but altogether the differences do not seem to be important enough to justify discarding Trinius's name in view of the evidence presented by the authentic specimens. It is highly probable that the specimen cited by Trinius was a duplicate from the Macrae collection, another specimen from the same collection being the type of Hackel's *Ischaemum lutescens*. I have therefore taken up Trinius's name. Oahu: Without locality, Remy 110 (Gray Herbarium).

Molokai: Wailau Valley, Forbes 527.

Hawaii: Hilo, Hitchcock 14144; Newell in 1917; Wilkes Expl. Exped. Halawa, Faurie 1349. Rainbow Falls near Hilo, Hitchcock 14194.

Without locality: Wilkes Expl. Exped.

Spodiopogon aureus Hook. & Arn. is admitted to the Hawaiian flora by Hillebrand on the authority of Munro but this reference is probably incorrect.

46. ANDROPOGON L.

Spikelets in pairs at each node of an articulate rachis, one sessile and perfect, the other pedicellate and either staminate, neuter, or reduced to the pedicel, the rachis and the pedicels of the sterile spikelets often villous, sometimes conspicuously so; glumes of the fertile spikelet coriaceous, narrow, awnless, the first rounded, flat, or concave on the back, several-nerved, the median nerve weak or wanting; sterile lemma shorter than the glumes, empty, hyaline; fertile lemma hyaline, narrow, entire, or bifid, usually bearing a bent and twisted awn from the apex or from between the lobes; palea hyaline, small, or wanting; pedicellate spikelet awnless, in some species staminate and about as large as the sessile spikelet, in some consisting of one or more reduced glumes, or glumes wanting, only the pedicel present. Rather coarse perennials with solid culms, the spikelets arranged in racemes, these numerous, aggregate on an exserted peduncle, or single, in pairs, or sometimes in threes or fours, the common peduncle usually inclosed by a spathelike sheath, these sheaths often numerous, forming a compound inflorescence.

²³ In De Candolle, Alphonso, et Casimir, Monographie phanerogamarum, Vol. 6, p. 222. 1889.

The Hawaiian species are all perennials belonging to the sections of the genus having the racemes aggregate at the end of the culms on an exserted peduncle. They have all been introduced for trial as forage grasses and have escaped from the plots where they were being grown.

- Racemes numerous, in whorls or fascicles, scattered along an axis 10 to 20 cm. long; awns about 1 cm. long..... 1. **A. intermedius**
 Racemes 2 to several, approximate at the summit of the culm; awns more than 1 cm. long.
 Culms pubescent below the panicle; spikelets pubescent but not silky..... 2. **A. nodosus**.
 Culms glabrous below the panicle.
 Awns brown; racemes moderately pilose..... 3. **A. sericeus**.
 Awns pale; racemes densely silky..... 4. **A. saccharoides**.

1. **Andropogon intermedius** R. Br. Prodr. Fl. Nov. Holl. 1:202. 1810.

Culms erect, 1 to 1.5 meters tall, glabrous, pilose at the nodes; sheaths smooth; blades flat or folded, elongate, about 5 mm. wide, glabrous, pilose around the base; panicle oblong, 10 to 20 cm. long, the axis smooth, the branches slender, in whorls, naked below, branching above, the branchlets appressed, pilose at base, bearing short racemes; joints of rachis pilose above, enlarged and cup-shaped at the upper end, about 2.5 mm. long and as long as the pedicel of the sterile floret, the latter pilose on the margins; sessile spikelet short-pilose at base, narrowly elliptic, about 4 mm. long, appressed-pilose, especially below; glumes about equal; sterile lemma narrow, two-thirds as long as the glumes; fertile lemma consisting of a slender awn about 1 cm. long, twisted below, obscurely geniculate above; sterile or pediceled spikelet consisting of a single elliptic glume 3 to 4 mm. long.

Cultivated ground; introduced. Originally described from Australia.
 Molokai: Eastern end, along edge of taro field, Hitchcock 15079.

2. **Andropogon nodosus** (Willem.) Nash, N. Amer. Fl. 17:122. 1912.

Dichanthium nodosum Willem. Ann. Bot. Usteri 18:11. 1796.

Andropogon caricosus mollicomus Hack. in DC. Monogr. Phan. 6:569. 1889.

Culms erect from a more or less geniculate base, glabrous, 1 to 1.5 meters tall, pubescent at the nodes; sheaths glabrous; blades flat, 10 to 20 cm. long, 2 to 6 mm. wide, pilose around the base, scabrous on the upper surface; panicle of 2 to 5 peduncled racemes approximate at the summit of the culm, this and the peduncles densely and softly pubescent; racemes flexuous, 3 to 8 cm. long, the spikelets crowded, the broad outer glumes of the sessile and pediceled spikelets imbricate, concealing the rachis and the remainder of the spikelet, the rachis pilose; sessile spikelet 4 mm. long, short-pilose at base; outer glume broad, oblong, rounded at the apex, several-nerved, appressed-pubescent on the lower half, hispidulous on the margin; second glume narrower than the first, about as long, keeled, glabrous on the back, pubescent along the margin; sterile lemma very thin, nearly as long as the glumes; fertile lemma very narrow, continued into a bronze-brown awn 1.5 cm. long, tightly twisted to the first bend, loosely twisted to the second bend, straight beyond.

Introduced for trial by G. P. Wilder and called Wilder grass. Tropics of Asia. Originally described from Mauritius.

Escaped from grounds of the United States Experiment Station.
 Oahu: Honolulu, Hitchcock 14071; Westgate in 1915.

3. **Andropogon sericeus** R. Br. Prodr. Fl. Nov. Holl. 201. 1810.

Culms erect, or decumbent at base, glabrous, pilose at the nodes, 50 to 100 cm. tall; sheaths glabrous; blades flat or more or less involute, often glaucous, scabrous, attenuate-pointed, 10 to 20 cm. long, 1 to 5 mm. wide, the uppermost very short; inflorescence of 2 to

several nearly digitate racemes 3 to 6 cm. long on a glabrous exserted peduncle; rachis internode and sterile pedicel about half as long as the spikelet, pilose with long ascending hairs; sessile spikelet about 3.5 mm. long; first glume membranaceous, oblong-oval, obtuse, faintly nerved, pilose at base and on the lower half of the back, the hairs appressed, papillose-pilose along the margin above and in a curved line across the top below the apex, the hairs 2 to 3 mm. long; second glume as long as the first, coriaceous, ridged along the middle, included in the inrolled edges of the first, glabrous, or with a few long hairs at the apex; sterile lemma very thin, acute, two-thirds as long as the glumes; fertile lemma very narrow, continued into an awn about 2.5 mm. long, this bronze-brown, tightly twisted to the second bend; pediceled spikelet about 3 mm. long, cuneate-terete below and pilose with short hairs at base, broad, flat, obtuse above, glabrous on the back, pilose with long hairs along the margin and apex, about 7-nerved; second glume thin, about two-thirds as long as the first, the flat edges turned inward, the tip minutely puberulent.

Escaped from grounds of the United States Experiment Station. Originally described from Australia. Called Australian blue grass.

Oahu: Honolulu, Hitchcock 14122, 15606; Westgate in 1915.

4. *Andropogon saccharoides* Swartz, Prodr. Veg. Ind. Occ. 26. 1788.

Culms erect 60 to 100 cm. tall, glabrous, the nodes pilose; sheaths glabrous; blades flat, 10 to 20 cm. long, 2 to 4 mm. wide, scabrous-pilose about the base; inflorescence an oval or flabellate mass of very silky racemes on a glabrous exserted peduncle, the panicle glossy white, 5 to 10 cm. long, the axis 2 to 4 cm. long; racemes 2 to 4 cm. long; rachis internodes about 3 mm. long, densely pilose with ascending silky-white hairs as much as 7 mm. above, the lower shorter, the sterile pedicel similar; first glume of sessile spikelet elliptic, about 5 mm. long, several-nerved, densely silky-pilose on the callus and on the lower part of the back, glabrous above, scabrous along the margin at the apex; second glume narrower and included in the incurved edges of the first glume, firm, strongly ridge-keeled, glabrous, scaberulous at tip, as long as the first glume; sterile lemma very thin, shorter than the glumes; fertile lemma very narrow, extending into a pale, obscurely geniculate awn about 2.5 cm. long, tightly twisted to the bend; pediceled spikelet narrow, about 5 mm. long, concealed in the silky hairs of the pedicel, reduced to a single scaberulous-pubescent glume (fig. 105).

Dry ground along roadside; introduced or escaped from cultivation. Originally described from Jamaica.

Oahu: Honolulu, near the United States Experiment Station, Hitchcock 14073.

Molokai: Ka Lae o Ka Laau, Rock 8703.

The lemon grass (*Cymbopogon citratus* (DC.) Stapf; *Andropogon citratus* DC.) is sometimes planted but has scarcely become established. It has been collected in the Hii Mountains, Kauai (Forbes 695). This is a robust reedlike grass, 2 to 3 meters tall, with a large compound inflorescence, a meter or more in length, the 2 short racemes subtended by spathe-like sheaths 1 to 2 cm. long. The outer glume of the sessile spikelet is concave on the back.

47. *HOLCUS* L.

(*Sorghum* Pers.)

Spikelets in pairs, one sessile and fertile, the other pedicellate, sterile but well developed, usually staminate, the terminal sessile spikelet with two pedicellate spikelets. Annual or perennial, tall or moderately tall grasses, with flat blades and terminal panicles of 1 to 5-jointed tardily disarticulating racemes.



FIGURE 107. *Rhapsis aciculata*. From Hitchcock 13713, Oahu.



FIGURE 108.—*Holcus halepensis*. From U. S. Dept. Agr. Bull. 772, fig. 162.

Plants perennial, with creeping rhizomes..... 1. **H. halepensis.**
 Plants annual..... 2. **H. sorghum.**

1. **Holcus halepensis** L. Sp. Pl. 1047. 1753. JOHNSON GRASS.

Andropogon halepensis Brot. Fl. Lusit. 1:89. 1804.

Sorghum halepense Pers. Syn. Pl. 1:101. 1805.

Plants perennial, with stout scaly creeping rhizomes; culms erect, glabrous, 60 to 120 cm. tall; sheaths glabrous; blades flat, 6 to 15 mm. wide, the white midrib prominent; panicle 15 to 25 cm. long, more or less spreading; sessile spikelet about 5 mm. long, lanceolate; glumes pubescent, becoming glabrous and shining except at base and margins; pediceled spikelets narrow, 4 mm. long, on pedicels 3 mm. long, the glumes membranaceous, nerved, glabrous (fig. 108).

Introduced in fields and along roadsides. Originally described from Syria. Oahu: Nuuanu Valley, Forbes 1331. Manoa Valley, Hitchcock 13734.

2. **Holcus sorghum** L. Sp. Pl. 1047. 1753. SORGHUM. SORGO.

Sorghum saccharatum Moench. Meth. 207. 1794.

Sorghum vulgare Pers. Syn. Pl. 1:101. 1805.

Plants annual, usually robust, the spikelet characters similar to those of *H. halepensis*, the panicle large and spreading or compact. Many varieties are in cultivation throughout the world. Some of these have been grown in the Hawaiian islands and may occasionally be found growing spontaneously, though I have seen no specimens except the Sudan grass (*H. sorghum sudanensis* (Piper) Hitchc. Proc. Biol. Soc. Washington 29:128. 1916; *Andropogon sorghum sudanensis* Piper, Proc. Biol. Soc. Washington 28:33. 1915.), which has been found on the experiment plots at Schofield Barracks and has escaped in the vicinity. It was also found at Honolulu (Hitchcock 13674) and Lihue (Forbes 591). Hillebrand²⁴ describes two species, *Sorghum vulgare*, the sorghum or Guinea corn, and *S. saccharatum* the sweet or sugar sorghum. Sudan grass is widely grown in the United States for forage.

48. **RHAPHIS** Lour.

Spikelets in threes, one sessile and perfect, the other two pedicellate and sterile, or a pair below, one fertile and one sterile; fertile spikelet terete, the glumes coriaceous; sterile and fertile lemmas thin and hyaline, the latter long-awned. Perennial grasses, with open panicles, the three spikelets (reduced racemes) borne at the ends of slender naked branches.

1. **Rhaphis aciculata** (Retz.) Desv. Opusc. 69. 1831.

Andropogon aciculatus Retz. Obs. Bot. 5:22. 1789.

Rhaphis trivialis Lour. Fl. Cochinch. 553. 1790.

Andropogon acicularis Willd. Sp. Pl. 4:906. 1806.

Chrysopogon aciculatus Trin. Fund. Agrost. 188. 1820.

Desvaux uses the specific name *aciculare*, basing it upon "*Andropogon aciculare* Retz."

Plants perennial, creeping and rooting, the base of the sterile shoots in open ground covered with imbricate, scalelike old sheaths; culms ascending or erect from a decumbent base, 10 to 30 cm. tall; sheaths glabrous, mostly overlapping, ciliate or villous on the margin; blades mostly toward the decumbent base of the culm, flat, glabrous, scabrous on the margin with sharp rather distant teeth, 2 to 5 cm. long, 3 to 5 mm. wide, the uppermost much reduced; panicle narrowly elliptic, 3 to 6 cm. long, the slender branches ascending or appressed, smooth, as much

²⁴ Op. cit., p. 511.



FIGURE 109.—*Ischaemum byrone*. From Hitchcock 14144. Hawaii.



FIGURE 110.—*Heteropogon contortus*. From U. S. Dept. Agr. Bull. 772, fig. 165.

as 1 to 1.5 cm. long, some in whorls, others scattered; spikelets in clusters of 3 at the ends of the branches, the cluster 6 to 8 mm. long, disarticulating from the pedicel or branch by a long oblique callus extending down one side as a brown appressed-hispidulous ridge 5 mm. long, the callus forming a retrorsely bearded or barbed point to the fruit; sessile spikelet excluding the callus about 4 mm. long, acute, glabrous, hispidulous-scabrous on the margins above, and on the keel of the second glume, the latter awned, the awn about 2 mm. long; sterile lemma nearly as long as the first glume; fertile lemma rather narrow, tapering into an awn 5 mm. long; grain oblong, 2 mm. long; sterile spikelets on pedicels 2 to 3 mm. long, the pedicel hispidulous at the summit; glumes acuminate or awn-pointed, about 5 mm. long, scabrous at the tip; lemmas about equal, awnless, shorter than the glumes (fig. 107).

Common and often dominant on the central plain of Oahu. (Pl. XXXI, C.) The detached fruits are very troublesome as they work their way into the clothing by the barbed callus. Called by the Hawaiians pilipiliula.

Rocky slopes and open rather dry grassland; probably introduced. Originally described from the East Indies.

Kauai: Lihue, Forbes 734. Hanapepe River, Heller 2476.

Oahu: Schofield Barracks, Hitchcock 13931. Palolo Valley, Hitchcock 14143.

Honolulu, Hitchcock 13713. Koko, Mann & Brigham 34. Hauula, Farmer 7.

Molokai: Pukoo, Hitchcock 15053. Above Kaluokoi, Rock 6179.

Hawaii: Hilo, Hitchcock 14171; Newell in 1917.

49. **HETEROPOGON** Pers.

Spikelets in pairs, one sessile, the other pedicellate, both of the lower few to several pairs staminate or neuter, the remainder of the sessile spikelets perfect, terete, long-awned, the pedicellate spikelets, like the lower, staminate, flat, conspicuous, awnless; glumes of the fertile spikelet equal, coriaceous, the first brown-hirsute, infolding the second; lemmas thin and hyaline, the fertile one narrow, extending into a strong bent and twisted brown awn; palea wanting; glumes of the staminate spikelet membranaceous, the first green, faintly many nerved, asymmetric, one submarginal keel rather broadly winged, the other wingless, the margins inflexed, the second glume narrower, symmetric; lemmas hyaline; palea wanting. Annual or perennial, often robust grasses, with flat blades and solitary racemes terminal on the culms and branches; rachis slender, the lower part, bearing the pairs of staminate spikelets, continuous, the remainder disarticulating obliquely at the base of each joint, the joint forming a sharp barbed callus below the fertile spikelet, the pedicellate spikelet readily falling.

1. **Heteropogon contortus** (L.) Beauv.; Roem. & Schult. Syst. Veg. 2:836. 1817.

Andropogon contortus L. Sp. Pl. 1045. 1753.

Plants perennial, caespitose, without rhizomes; culms erect, glabrous, 50 to 100 cm. tall; sheaths glabrous, compressed-keeled; blades mostly folded, glabrous, 10 to 30 cm. long, 2 to 5 mm. wide when unfolded; racemes excluding the awns 4 to 8 cm. long, somewhat falcate, 1-sided, green or tawny, the awns brown; outer glumes 7 to 8 mm. long, more or less papillose-hispid; awn of fertile lemma about 10 cm. long, with two rather indistinct bends, the terminal segment about 5 cm. long (fig. 110).

Called by the Hawaiians pili grass and used by them to form the walls of huts by binding to the frame. (Pl. XXXI, A.)

Open rocky slopes. Tropics of both hemispheres. Originally described from India.

Kauai: Nonou Mountains, Forbes 594a. Hanapepe River, Heller 2522.

- Oahu: Honolulu, Hitchcock 13721, 14069. Without locality, Mann & Brigham 2; Didrichson, 1845-47; Remy 109 (Gray Herbarium).
 Molokai: Pukoo, Hitchcock 15053. Above Kaluokoi, Rock 6179.
 Lanai: Hitchcock 14686.
 Hawaii: Hilo, Hitchcock 14202.
 Without locality: "Sandwich Islands" Wilkes Expl. Exped.

50. COIX L.

Spikelets unisexual; staminate spikelets 2-flowered, in twos or threes on the continuous rachis, the normal group consisting of a pair of sessile spikelets with a single pedicellate spikelet between them, this sometimes reduced to a pedicel or wanting; glumes membranaceous, obscurely nerved; lemma hyaline, nearly as long as the glumes, awnless, 5-nerved; palea hyaline, a little shorter than the lemma; stamens 3; pistillate spikelets 3 together, 1 fertile and 2 sterile at the base of the inflorescence; fertile spikelet consisting of 2 glumes, 1 sterile lemma, a fertile lemma, and a palea; glumes several-nerved, hyaline below, chartaceous in the upper narrow pointed part, the first very broad, infolding the spikelet, the margins infolded beyond the 2 lateral stronger pair of nerves, the second glume narrower than the first, keeled; sterile lemma about as long as the second glume, similar in shape, but a little narrower, hyaline below, somewhat chartaceous above; fertile lemma hyaline, narrow, somewhat shorter than the sterile lemma; palea hyaline, narrow, shorter than the lemma; sterile spikelets consisting of a single narrow tubular glume as long as the fertile spikelet, somewhat chartaceous. Tall branched grasses with broad flat blades, the monoecious inflorescences numerous on long, stout peduncles clustered in the axils of the leaves, each inflorescence consisting of an ovate or oval, pearly white or drab, beadlike, very hard, tardily deciduous involucre (much modified sheathing bract) containing the pistillate lower portion of the inflorescence, the points of the pistillate spikelets and the slender axis of the staminate portion of the inflorescence protruding through the orifice at the apex, the staminate upper portion of the inflorescence 2 to 4 cm. long, soon deciduous, consisting of several clusters of staminate spikelets.

1. *Coix lachryma-jobi* L. Sp. Pl. 972. 1753. JOB'S TEARS.

Freely branching perennial as much as 1 meter tall; blades cordate-clasping, 2 to 3 cm. wide; involucre or "beads" 8 to 10 mm. long (fig. 99).

Moist places; introduced. Originally described from the East Indies.

Kauai: Along Hanapepe River, Heller 2554.

Oahu: Upper Manoa Valley, Hitchcock 13738.

Hawaii: Hilo, Hitchcock 14176.

Indian corn or maize (*Zea mays* L. Sp. Pl. 971. 1753) is cultivated and waifs are found occasionally.

The following species were received too late to be included in the text:

Bromus rubens L. Cent. Pl. 1:5. 1755. An annual with compact ovoid inflorescence, narrow spikelets, and straight awns about 2 centimeters long. Puu Oo Ranch, Hawaii. Introduced from Europe. Communicated by Dr. H. L. Lyon.

Bromus sterilis L. Sp. Pl. 77. 1753. An annual with open panicle, pendulous, narrow, glabrous spikelets, the awns 1.5 to 2.5 centimeters long. Parker Ranch, Hawaii. Introduced from Europe. Communicated by Dr. H. L. Lyon.

Axonopus compressus (Swartz) Beauv. Ess. Agrost. 12. 1812. (*Milium compressum* Swartz, Prodr. Veg. Ind. Occ. 24. 1728. *Paspalum compressum* Raspail, Ann. Sci. Nat. 5:301. 1825.) Carpet grass. A glabrous stoloniferous perennial, with flat thin blades 8 to 10 mm. wide, and 2 to 5 slender racemes along a short axis. Kona, Hawaii. Introduced from tropical America. Collected by Herbert Shipman and communicated by Dr. H. L. Lyon.

Chaetochloa barbata (Lam.) Hitchcock & Chase, Contr. U. S. Nat. Herb. 18:348. 1917. (*Panicum barbatum* Lam. Tabl. Encycl. 1:171. 1791.) A weak-stemmed geniculate annual with thin, scabrous, more or less plicate blades 1 to 3 centimeters wide, narrow rather open panicles, belonging to the section Ptychophyllum. Introduced from tropical Asia. Mrs. Foster's grounds, Honolulu. Hitchcock 16699.

CATALOG OF SPECIMENS CITED

Unless otherwise stated all specimens cited are in the United States National Herbarium. List is arranged by collectors' names and numbers.

- | | |
|-------------------------------------|---|
| BRYAN | |
| 8729. <i>Cenchrus agrimonioides</i> | 8731. <i>Eragrostis variabilis</i> |
| 8730. <i>Eragrostis variabilis</i> | |
| CURRAN | |
| 18. <i>Chloris gayana</i> | |
| DIDRICHSEN | |
| | 3444. <i>Capriola dactylon</i> |
| FARMER | |
| 7. <i>Rhaphis aciculata</i> | 12. <i>Capriola dactylon</i> |
| 11. <i>Paspalum orbiculare</i> | 16. <i>Syntherisma chinensis</i> |
| FAURIE | |
| 1282. <i>Chloris paraguayensis</i> | 1340. <i>Garnotia sandwicensis</i> |
| 1283. <i>Chloris radiata</i> | 1348. <i>Stenotaphrum secundatum</i> |
| 1284. <i>Aira nubigena</i> | 1349. <i>Ischaemum byrone</i> |
| 1300. <i>Syntherisma chinensis</i> | 1354. <i>Tricholaena rosea</i> |
| 1306. <i>Poa mannii</i> | 1356. <i>Gastridium ventricosum</i> [presumably Faurie] |
| 1316. <i>Panicum xerophilum</i> | 1358. <i>Trisetum glomeratum</i> |
| 1318. <i>Panicum fauriei</i> | 1359. <i>Trisetum glomeratum</i> |
| 1320. <i>Sporobolus virginicus</i> | 1363. <i>Aira nubigena</i> |
| 1329. <i>Eragrostis grandis</i> | 1366. <i>Aira nubigena</i> |
| 1332. <i>Eragrostis variabilis</i> | |
| FORBES | |

Specimens are independently numbered for each island. Duplicate numbers are here distinguished by the initial letter of the island represented.

- | | |
|-----------------------------------|---------------------------------------|
| 15. <i>Panicum imbricatum</i> | 217. <i>Eragrostis monticola</i> |
| 16. <i>Eragrostis variabilis</i> | 218. <i>Panicum kaalaense</i> |
| 43. <i>Eragrostis leptophylla</i> | 219. <i>Dissochondrus biflorus</i> |
| 47. <i>Eragrostis variabilis</i> | 236. <i>Isachne distichophylla</i> |
| 58. <i>Eragrostis variabilis</i> | 253. <i>Garnotia sandwicensis</i> |
| 70. <i>Eragrostis grandis</i> | 256. <i>Isachne distichophylla</i> |
| 95. <i>Dactylis glomerata</i> | 258. <i>Eragrostis leptophylla</i> |
| 96. <i>Anthoxanthum odoratum</i> | 259. <i>Panicum tenuifolium</i> |
| 98. <i>Agrostis stolonifera</i> | 261H. <i>Polypogon lutosus</i> |
| 99. <i>Lolium multiflorum</i> | 261M. <i>Syntherisma chinensis</i> |
| 102. <i>Festuca bromoides</i> | 263. <i>Poa pratensis</i> |
| 150. <i>Panicum torridum</i> | 277. <i>Isachne distichophylla</i> |
| 168. <i>Trisetum glomeratum</i> | 294. <i>Aira nubigena</i> |
| 170H. <i>Aira nubigena</i> | 306. <i>Garnotia sandwicensis</i> |
| 170M. <i>Sporobolus elongatus</i> | 313. <i>Panicum tenuifolium</i> |
| 171. <i>Polypogon lutosus</i> | 315a. <i>Panicum tenuifolium</i> |
| 182. <i>Eragrostis grandis</i> | 320. <i>Eragrostis grandis</i> |
| 190. <i>Panicum isachnoides</i> | 324. <i>Dactylis glomerata</i> |
| 191H. <i>Eragrostis deflexa</i> | 325. <i>Paspalum dilatatum</i> |
| 191M. <i>Panicum imbricatum</i> | 358. <i>Isachne distichophylla</i> |
| 199. <i>Aira nubigena</i> | 367. <i>Eragrostis grandis</i> |
| 205. <i>Festuca megalura</i> | 368. <i>Aira nubigena</i> |
| 211. <i>Festuca bromoides</i> | 369. <i>Calamagrostis hillebrandi</i> |

371. Calamagrostis expansa
 379. Panicum nephelophilum
 390. Panicum imbricatum
 393. Cenchrus hillebrandianus
 401. Panicum imbricatum
 402. Panicum imbricatum
 412. Isachne distichophylla
 413. Eragrostis grandis
 405. Capriola dactylon
 406. Syntherisma sanguinalis
 474. Agrostis sandwicensis
 478. Echinochloa crusgalli crus-pavonis
 479. Paspalum orbiculare
 480. Echinochloa crusgalli crus-pavonis
 487. Eragrostis grandis
 495. Oplismenus hirtellus
 497. Oplismenus hirtellus
 527. Ischaenum byrone
 558. Isachne distichophylla
 582. Syntherisma pruriens
 591. Holcus sorghum sudanensis
 594a. Heteropogon contortus
 624. Eragrostis variabilis
 625. Tricholaena rosea
 630. Echinochloa crusgalli crus-pavonis
 695. Cymbopogon citratus
 703. Panicum kauaiense
 710. Isachne distichophylla
 714. Eragrostis variabilis
 734. Rhaphis aciculata
 735. Eleusine indica
 737. Paspalum dilatatum
 774. Agrostis verticillata
 775. Panicum kaalaense
 796. Poa sandwicensis
 805. Aira nubigena
 811. Panicum hillebrandianum
 820. Panicum nephelophilum
 830. Trisetum glomeratum
 852. Aira nubigena
 853. Trisetum glomeratum
 854. Trisetum glomeratum
 855H. Trisetum glomeratum
 855K. Eragrostis variabilis
 863. Poa annua
 875. Aira nubigena
 879. Panicum imbricatum
 949. Eragrostis variabilis
 990. Festuca bromoides
 992. Poa sandwicensis
 1013. Eragrostis grandis
 1018. Agrostis stolonifera
 1021. Cenchrus hillebrandianus
 1052. Panicum forbesii
 1055. Isachne pallens
 1063. Eragrostis grandis
 1074K. Dactylis glomerata
 1074O. Dactyloctenium aegyptium
 1086. Eragrostis variabilis
 1087. Eragrostis variabilis
 1191. Schizostachyum glaucifolium
 1331. Holcus halepensis
 1454. Panicum torridum
 1522. Stenotaphrum secundatum
 1523. Chaetochloa geniculata
 1526. Briza minor
 1603. Isachne pallens
 1686. Festuca megalura
 1692. Agrostis retrofracta
 1693. Panicum kaalaense
 1714. Syntherisma sanguinalis
 1715. Sporobolus diander
 1717. Paspalum orbiculare
 1845. Isachne distichophylla
 1938. Tricholaena rosea
 1951. Oplismenus hirtellus
 2294. Eragrostis variabilis
 2403. Eragrostis variabilis
 2414. Panicum nubigenum
 2415. Panicum torridum
 2447. Panicum nubigenum
 2449. Panicum torridum
 2455. Panicum torridum

HANCE

4926. Panicum lanaiense

HAPEMAN

7. Poa pratensis

HELLER

1960. Capriola dactylon
 1961. Chaetochloa verticillata
 1962. Eragrostis amabilis
 1963. Chloris radiata
 1964. Cenchrus hillebrandianus
 1971. Paspalum orbiculare
 1972. Syntherisma pruriens
 1975. Paspalum conjugatum
 1978. Echinochloa colonum
 1992. Eragrostis variabilis
 2061. Oplismenus hirtellus
 2210. Polypogon lutosus
 2288. Eragrostis cilianensis
 2289. Chaetochloa verticillata
 2290. Eleusine indica
 2320. Syntherisma sanguinalis

2321. *Syntherisma chinensis*
 2359. *Stenotaphrum secundatum*
 2384. *Echinochloa crusgalli crus-pavonis*
 2384a. *Echinochloa crusgalli crus-pavonis*
 2469. *Chaetochloa geniculata*
 2476. *Rhaphis aciculata*

2489. *Isachne pallens*
 2522. *Heteropogon contortus*
 2554. *Coix lachryma-jobi*
 2779. *Agrostis retrofracta*
 2830. *Eragrostis variabilis*
 2850. *Panicum nephelophilum*

HILLEBRAND

484. *Oplismenus hirtellus*
 490. *Stenotaphrum secundatum*

492. *Paspalum conjugatum*

HITCHCOCK

13672. *Paspalum fimbriatum*
 13674. *Holcus sorghum sudanensis*
 13681. *Chloris radiata*
 13682. *Dactyloctenium aegyptium*
 13683. *Syntherisma sanguinalis*
 13707. *Chaetochloa verticillata*
 13708. *Capriola dactylon*
 13709. *Echinochloa colonum*
 13710. *Eleusine indica*
 13711. *Chloris paraguayensis*
 13712. *Syntherisma chinensis*
 13713. *Rhaphis aciculata*
 13720. *Eragrostis amabilis*
 13721. *Heteropogon contortus*
 13723. *Eragrostis amabilis*
 13729. *Paspalum conjugatum*
 13730. *Paspalum orbiculare*
 13732. *Chaetochloa palmifolia*
 13734. *Holcus halepensis*
 13735. *Syntherisma pruriens*
 13736. *Echinochloa crusgalli crus-pavonis*
 13737. *Paspalum larranagai*
 13738. *Coix lachryma-jobi*
 13746. *Echinochloa colonum*
 13747. *Festuca bromoides*
 13749. *Avena fatua*
 13750. *Poa annua*
 13751. *Polypogon monspeliensis*
 13768. *Stenotaphrum secundatum*
 13776. *Oplismenus hirtellus*
 13778. *Lolium temulentum*
 13779. *Festuca bromoides*
 13780. *Phalaris paradoxa*
 13782. *Poa annua*
 13783. *Chaetochloa geniculata*
 13789. *Polypogon lutosus*
 13790. *Eragrostis variabilis*
 13791. *Eragrostis variabilis*
 13792. *Paspalum orbiculare*
 13799. *Briza minor*
 13800. *Echinochloa crusgalli crus-pavonis*
 13801. *Cenchrus hillebrandianus*
 13802. *Eragrostis cilianensis*

13803. *Paspalum distichum*
 13841. *Valota insularis*
 13843. *Eragrostis caroliniana*
 13844. *Bromus molliformis*
 13846. *Echinochloa crusgalli crus-pavonis*
 13849. *Chloris truncata*
 13854. *Cenchrus echinatus*
 13858. *Panicum maximum*
 13859. *Lolium multiflorum*
 13862. *Syntherisma pruriens*
 13863. *Syntherisma chinensis*
 13868. *Festuca megalura*
 13869. *Agrostis stolonifera*
 13870. *Agrostis retrofracta*
 13877. *Chaetochloa palmifolia*
 13879. *Paspalum orbiculare*
 13880. *Chaetochloa geniculata*
 13884. *Sporobolus virginicus*
 13900. *Echinochloa crusgalli crus-pavonis*
 13901. *Echinochloa crusgalli crus-pavonis*
 13914. *Bromus molliformis*
 13915. *Phalaris minor*
 13917. *Lolium multiflorum*
 13920. *Hordeum murinum*
 13922. *Bromus rigidus gussonei*
 13923. *Lolium multiflorum*
 13928. *Eragrostis grandis*
 13930. *Paspalum orbiculare*
 13931. *Rhaphis aciculata*
 13934. *Avena barbata*
 13935. *Paspalum orbiculare*
 13939. *Festuca bromoides*
 13940. *Sporobolus elongatus*
 13941. *Syntherisma chinensis*
 13946. *Chloris gayana*
 13947. *Agrostis retrofracta*
 13949. *Sporobolus elongatus*
 13950. *Eragrostis grandis*
 13951. *Eragrostis grandis*
 13952. *Dissochondrus biflorus*
 13959. *Agrostis retrofracta*
 13960. *Cenchrus hillebrandianus*
 13962. *Secale cereale*

13963. *Hordeum vulgare*
 13964. *Triticum aestivum*
 13965. *Triticum aestivum*
 13966. *Triticum aestivum*
 13972. *Avena sativa*
 13975. *Bromus molliformis*
 13977. *Syntherisma chinensis*
 13978. *Paspalum orbiculare*
 13980. *Tricholaena rosea*
 13981. *Paspalum dilatatum*
 14013. *Panicum kaalaense*
 14014. *Panicum nephelophilum*
 14020. *Paspalum orbiculare*
 14031. *Echinochloa crusgalli crus-pavonis*
 14035. *Oplismenus hirtellus*
 14048. *Gastridium ventricosum*
 14054. *Chaetochloa geniculata*
 14057. *Oplismenus hirtellus*
 14064. *Bouteloua curtipendula*
 14065. *Chaetochloa verticillata*
 14066. *Chloris paraguayensis*
 14067. *Paspalum conjugatum*
 14068. *Cenchrus hillebrandianus*
 14069. *Heteropogon contortus*
 14070. *Sporobolus diander*
 14071. *Andropogon nodosus*
 14072. *Paspalum dilatatum*
 14073. *Andropogon saccharoides*
 14074. *Eragrostis amabilis*
 14075. *Bouteloua curtipendula*
 14076. *Chaetochloa palmifolia*
 14077. *Chaetochloa geniculata*
 14081. *Paspalum larranagai*
 14088. *Chloris gayana*
 14101. *Echinochloa crusgalli crus-pavonis*
 14107. *Syntherisma chinensis*
 14117. *Echinochloa crusgalli crus-pavonis*
 14119. *Echinochloa crusgalli crus-pavonis*
 14121. *Chloris radiata*
 14122. *Andropogon sericeus*
 14123. *Eragrostis abyssinica*
 14139. *Eragrostis variabilis*
 14141. *Eragrostis variabilis*
 14142. *Eragrostis variabilis*
 14143. *Rhaphis aciculata*
 14144. *Ischaemum byrone*
 14145. *Panicum repens*
 14148. *Chaetochloa palmifolia*
 14151. *Echinochloa crusgalli crus-pavonis*
 14152. *Stenotaphrum secundatum*
 14169. *Syntherisma chinensis*
 14171. *Rhaphis aciculata*
 14175. *Pennisetum macrostachyum*
 14176. *Coix lachryma-jobi*
 14181. *Echinochloa crusgalli crus-pavonis*
 14182. *Paspalum conjugatum*
 14183. *Panicum barbinode*
 14186. *Syntherisma longiflora*
 14188. *Syntherisma chinensis*
 14190. *Syntherisma pruriens*
 14191. *Syntherisma sanguinalis*
 14192. *Paspalum orbiculare*
 14193. *Garnotia sandwicensis*
 14194. *Ischaemum byrone*
 14195. *Agrostis retrofracta*
 14197. *Festuca megalura*
 14198. *Aira nubigena*
 14199. *Oplismenus hirtellus*
 14202. *Heteropogon contortus*
 14203. *Sporobolus elongatus*
 14204. *Notholcus lanatus*
 14205. *Agrostis retrofracta*
 14206. *Tricholaena rosea*
 14208. *Panicum tenuifolium*
 14209. *Briza minor*
 14210. *Festuca megalura*
 14211. *Bromus unioloides*
 14212. *Anthoxanthum odoratum*
 14213. *Dactylis glomerata*
 14214. *Paspalum dilatatum*
 14215. *Festuca bromoides*
 14216. *Agrostis stolonifera*
 14219. *Bromus rigidus gussonei*
 14220. *Eragrostis grandis*
 14221. *Agrostis verticillata*
 14223. *Poa annua*
 14225. *Aira nubigena*
 14231. *Agrostis stolonifera*
 14232. *Agrostis retrofracta*
 14235. *Trisetum glomeratum*
 14243. *Agrostis sandwicensis*
 14244. *Trisetum glomeratum*
 14245. *Agrostis exarata microphylla*
 14250. *Aira nubigena*
 14251. *Panicum tenuifolium*
 14252. *Notholcus lanatus*
 14256. *Panicum tenuifolium*
 14264. *Panicum tenuifolium*
 14266. *Bromus racemosus*
 14267. *Arrhenatherum elatius*
 14269. *Poa annua*
 14284. *Trisetum glomeratum*
 14285. *Agrostis sandwicensis*
 14296. *Chloris gayana*
 14298. *Agrostis sandwicensis*
 14299. *Trisetum glomeratum*
 14348. *Hordeum murinum*
 14376. *Agrostis retrofracta*
 14395. *Isachne distichophylla*
 14413. *Panicum tenuifolium*
 14418. *Agrostis sandwicensis*
 14419. *Trisetum glomeratum*

14431. *Trisetum glomeratum*
 14434. *Bromus hordeaceus*
 14435. *Festuca bromoides*
 14436. *Festuca bromoides*
 14437. *Aira nubigena*
 14440. *Eragrostis leptophylla*
 14442. *Poa compressa*
 14445. *Eragrostis atropioides*
 14446. *Festuca hawaiiensis*
 14447. *Eragrostis leptophylla*
 14448. *Eragrostis leptophylla*
 14450. *Poa pratensis*
 14452. *Agrostis sandwicensis*
 14453. *Trisetum glomeratum*
 14455. *Poa annua*
 14457. *Trisetum glomeratum*
 14458. *Eragrostis leptophylla*
 14459. *Eragrostis atropioides*
 14461. *Chaetochloa lutescens*
 14462. *Echinochloa crusgalli crus-pavonis*
 14464. *Bromus unioloides*
 14465. *Microlaena stipoides*
 14474. *Agrostis verticillata*
 14475. *Panicum kaalaense*
 14476. *Eragrostis deflexa*
 14479. *Oplismenus hirtellus*
 14492. *Chloris gayana*
 14493. *Eragrostis atropioides*
 14494. *Eragrostis deflexa*
 14495. *Eragrostis atropioides*
 14510. *Trisetum glomeratum*
 14511. *Festuca bromoides*
 14518. *Panicum tenuifolium*
 14519. *Eragrostis brownei*
 14520. *Trisetum glomeratum*
 14521. *Aira nubigena*
 14527. *Trisetum glomeratum*
 14529. *Agrostis sandwicensis*
 14530. *Festuca megalura*
 14531. *Agrostis retrofracta*
 14536. *Festuca hawaiiensis*
 14544. *Oplismenus hirtellus*
 14591. *Eragrostis variabilis*
 14592. *Agrostis sandwicensis*
 14593. *Eragrostis deflexa*
 14598. *Isachne distichophylla*
 14602. *Sacciolepis contracta*
 14604. *Agrostis sandwicensis*
 14605. *Polypogon monspeliensis*
 14610. *Cenchrus hillebrandianus*
 14611. *Eragrostis variabilis*
 14615. *Sacciolepis contracta*
 14621. *Trisetum glomeratum*
 14622. *Aira nubigena*
 14631. *Agrostis sandwicensis*
 14640. *Agrostis retrofracta*
 14641. *Chloris gayana*
 14642. *Isachne distichophylla*
 14686. *Heteropogon contortus*
 14688. *Eragrostis grandis*
 14691. *Eragrostis grandis*
 14692. *Eragrostis grandis*
 14693. *Eragrostis monticola*
 14715. *Eragrostis deflexa*
 14716. *Cenchrus hillebrandianus*
 14719. *Panicum torridum*
 14722. *Chloris radiata*
 14728. *Aira nubigena*
 14729. *Agrostis fallax*
 14730. *Calamagrostis hillebrandi*
 14731. *Panicum hillebrandianum*
 14732. *Panicum imbricatum*
 14733. *Panicum isachnoides*
 14764. *Agrostis retrofracta*
 14810. *Eragrostis grandis*
 14825. *Aira nubigena*
 14830. *Calamagrostis expansa*
 14871. *Polypogon lutosus*
 14878. *Oplismenus hirtellus*
 14879. *Oplismenus hirtellus*
 14885. *Agrostis retrofracta*
 14887. *Sacciolepis contracta*
 14899. *Aira nubigena*
 14907. *Aira nubigena*
 14910. *Sacciolepis contracta*
 14922. *Poa annua*
 14931. *Briza minor*
 14934. *Sporobolus elongatus*
 14935. *Festuca bromoides*
 14937. *Syntherisma chinensis*
 14938. *Aspris caryophyllea*
 14942. *Aira nubigena*
 14946. *Eragrostis grandis*
 14953. *Trisetum glomeratum*
 14959. *Trisetum glomeratum*
 14963. *Eragrostis grandis*
 14965. *Aira nubigena*
 14969. *Aira nubigena*
 14973. *Aspris caryophyllea*
 14975. *Festuca bromoides*
 14976. *Agrostis sandwicensis*
 14988. *Phalaris minor*
 14993. *Trisetum glomeratum*
 14996. *Panicularia fluitans*
 14998. *Trisetum glomeratum*
 14999. *Phalaris californica*
 15041. *Oplismenus hirtellus*
 15048. *Stenotaphrum secundatum*
 15053. *Heteropogon contortus*
 15054. *Paspalum orbiculare*
 15056. *Cenchrus hillebrandianus*
 15058. *Rhaphis aciculata*

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| 15065. <i>Syntherisma chinensis</i> | 15229. <i>Poa mannii</i> |
| 15079. <i>Andropogon intermedius</i> | 15249. <i>Chaetochloa geniculata</i> |
| 15103. <i>Agrostis retrofracta</i> | 15250. <i>Chloris radiata</i> |
| 15104. <i>Aira nubigena</i> | 15253. <i>Agrostis retrofracta</i> |
| 15105. <i>Echinochloa crusgalli crus-pavonis</i> | 15257. <i>Syntherisma consanguinea</i> |
| 15110. <i>Echinochloa crusgalli crus-pavonis</i> | 15260. <i>Syntherisma chinensis</i> |
| 15130. <i>Sporobolus virginicus</i> | 15274. <i>Eragrostis variabilis</i> |
| 15145. <i>Panicum fauriei</i> | 15284. <i>Panicum nephelophilum</i> |
| 15150. <i>Tricholaena rosea</i> | 15301. <i>Agrostis verticillata</i> |
| 15152. <i>Lolium multiflorum</i> | 15309. <i>Poa sandvicensis</i> |
| 15153. <i>Paspalum dilatatum</i> | 15340. <i>Aira nubigena</i> |
| 15154. <i>Eragrostis grandis</i> | 15436. <i>Panicum nephelophilum</i> |
| 15155. <i>Eragrostis monticola</i> | 15503. <i>Panicum cynodon</i> |
| 15156. <i>Bromus unioloides</i> | 15504. <i>Panicum isachnoides</i> |
| 15159. <i>Dactylis glomerata</i> | 15505. <i>Panicum isachnoides</i> |
| 15162. <i>Sporobolus elongatus</i> | 15505½. <i>Panicum imbricatum</i> |
| 15164. <i>Briza minor</i> | 15506. <i>Aira nubigena</i> |
| 15170. <i>Anthoxanthum odoratum</i> | 15517. <i>Panicum cynodon</i> |
| 15186. <i>Calamagrostis hillebrandi</i> | 15518. <i>Panicum isachnoides</i> |
| 15195. <i>Panicum imbricatum</i> | 15536. <i>Poa siphonoglossa</i> |
| 15199. <i>Agrostis retrofracta</i> | 15543. <i>Eragrostis variabilis</i> |
| 15210. <i>Briza minor</i> | 15561. <i>Paspalum fimbriatum</i> |
| 15223. <i>Agrostis retrofracta</i> | 15606. <i>Andropogon sericeus</i> |

MANN AND BRIGHAM

- | | |
|---|-------------------------------------|
| 1. <i>Cenchrus hillebrandianus</i> | 251. <i>Eragrostis variabilis</i> |
| 2. <i>Heteropogon contortus</i> | 268. <i>Echinochloa colonum</i> |
| 15. <i>Eragrostis variabilis</i> | 272. <i>Panicum torridum</i> |
| 20. <i>Oplismenus hirtellus</i> | 273. <i>Agrostis verticillata</i> |
| 24. <i>Echinochloa crusgalli crus-pavonis</i> | 274. <i>Poa mannii</i> |
| 34. <i>Raphis aciculata</i> | 279. <i>Eragrostis grandis</i> |
| 44. <i>Eragrostis falcata</i> | 300. <i>Panicum nephelophilum</i> |
| 59. <i>Paspalum orbiculare</i> | 306. <i>Aira nubigena</i> |
| 71. <i>Eragrostis cilianensis</i> | 326. <i>Trisetum glomeratum</i> |
| 88. <i>Stenotaphrum secundatum</i> | 368. <i>Poa sandvicensis</i> |
| 213. <i>Isachne distichophylla</i> | 383. <i>Panicum lanaiense</i> |
| 218. <i>Eragrostis variabilis</i> | 435. <i>Panicum hillebrandianum</i> |
| 237. <i>Panicum tenuifolium</i> | 459. <i>Poa annua</i> |
| 245. <i>Sporobolus virginicus</i> | |

MUNRO

- | | |
|-----------------------------------|------------------------------------|
| 6. <i>Panicum beecheyi</i> | 334. <i>Panicum nephelophilum</i> |
| 6b. <i>Panicum beecheyi</i> | 346. <i>Isachne distichophylla</i> |
| 7. <i>Echinochloa colonum</i> | 364. <i>Isachne distichophylla</i> |
| 272. <i>Panicum nephelophilum</i> | 404. <i>Cenchrus agrimonioides</i> |
| 295. <i>Panicum xerophilum</i> | 467. <i>Panicum nephelophilum</i> |
| 317. <i>Trisetum glomeratum</i> | |

REMY

NOTE.—Two sheets are numbered 82.

- | | |
|-----------------------------------|------------------------------------|
| 75. <i>Agrostis sandwicensis</i> | 103. <i>Paspalum orbiculare</i> |
| 76. <i>Chloris radiata</i> | 104. <i>Oplismenus hirtellus</i> |
| 82. <i>Capriola dactylon</i> | 106. <i>Chaetochloa geniculata</i> |
| 82. <i>Trisetum glomeratum</i> | 109. <i>Heteropogon contortus</i> |
| 89. <i>Eragrostis variabilis</i> | 110. <i>Ischaemum byrone</i> |
| 92. <i>Eragrostis leptophylla</i> | |

Rock

- | | |
|---|---|
| 10. <i>Lepturus repens</i> | 8403. <i>Bromus rigidus gussonei</i> |
| 2180. <i>Eragrostis variabilis</i> | 8404. <i>Trisetum glomeratum</i> |
| 2545. <i>Panicum torridum</i> | 8405. <i>Eragrostis atropioides</i> |
| 3114. <i>Aira nubigena</i> | 8407. <i>Bromus unioloides</i> |
| 3155. <i>Festuca bromoides</i> | 8408. <i>Aira nubigena</i> |
| 3198. <i>Hordeum murinum</i> | 8508. <i>Agrostis sandwicensis</i> |
| 3212. <i>Dactylis glomerata</i> | 8511. <i>Aira nubigena</i> |
| 3219. <i>Aira nubigena</i> | 8512. <i>Trisetum glomeratum</i> |
| 3260. <i>Trisetum glomeratum</i> | 8558. <i>Gastridium ventricosum</i> |
| 3298. <i>Festuca bromoides</i> | 8703. <i>Andropogon saccharoides</i> |
| 3322. <i>Festuca bromoides</i> | 8704. <i>Panicum torridum</i> |
| 3437. <i>Notholcus lanatus</i> | 8705. <i>Panicum xerophilum</i> |
| 3457. <i>Briza minor</i> | 8708. <i>Panicum pellitum</i> |
| 3461. <i>Lolium multiflorum</i> | 8709. <i>Trisetum glomeratum</i> |
| 3462. <i>Agrostis retrofracta</i> | 9018. <i>Poa siphonoglossa</i> |
| 3467. <i>Festuca bromoides</i> | 12580. <i>Agrostis sandwicensis</i> |
| 3628. <i>Trisetum glomeratum</i> | 12638. <i>Panicum nephelophilum</i> |
| 4135. <i>Isachne distichophylla</i> | 12639. <i>Poa sandwicensis</i> |
| 4176. <i>Aira nubigena</i> | 12733. <i>Eragrostis grandis</i> |
| 4179. <i>Eragrostis grandis</i> | 12736. <i>Eragrostis variabilis</i> |
| 4189. <i>Polypogon monspeliensis</i> | 12738. <i>Agrostis canina</i> |
| 4508. <i>Sporobolus elongatus</i> | 12740. <i>Eragrostis variabilis</i> |
| 4511. <i>Tricholaena rosea</i> | 12741. <i>Eragrostis variabilis</i> |
| 4519. <i>Chaetochloa palmifolia</i> | 12766. <i>Panicum nubigenum</i> |
| 4527. <i>Paspalum orbiculare</i> | 14005. <i>Panicum xerophilum</i> |
| 4536. <i>Echinochloa crusgalli crus-pavonis</i> | 16001. <i>Agrostis fallax</i> |
| 4545. <i>Syntherisma pruriens</i> | 16002. <i>Eragrostis grandis</i> |
| 5120. <i>Agrostis verticillata</i> | 16003. <i>Calamagrostis hillebrandi</i> |
| 5124. <i>Agrostis retrofracta</i> | 16004. <i>Agrostis sandwicensis</i> |
| 5128. <i>Bromus hordeaceus</i> | 16005. <i>Eragrostis grandis</i> |
| 5129. <i>Eragrostis grandis</i> | 17072. <i>Eragrostis grandis</i> |
| 5131. <i>Eragrostis variabilis</i> | 17081. <i>Dissochondrus biflorus</i> |
| 5644. <i>Panicum imbricatum</i> | 17082. <i>Panicum kaalaense</i> |
| 6148. <i>Eragrostis monticola</i> | 17087. <i>Eragrostis grandis</i> |
| 6179. <i>Heteropogon contortus</i> | 17260. <i>Eragrostis variabilis</i> |
| 8139. <i>Aira nubigena</i> | 17326. <i>Isachne pallens</i> |
| 8190. <i>Calamagrostis hillebrandi</i> | |

SEEMAN

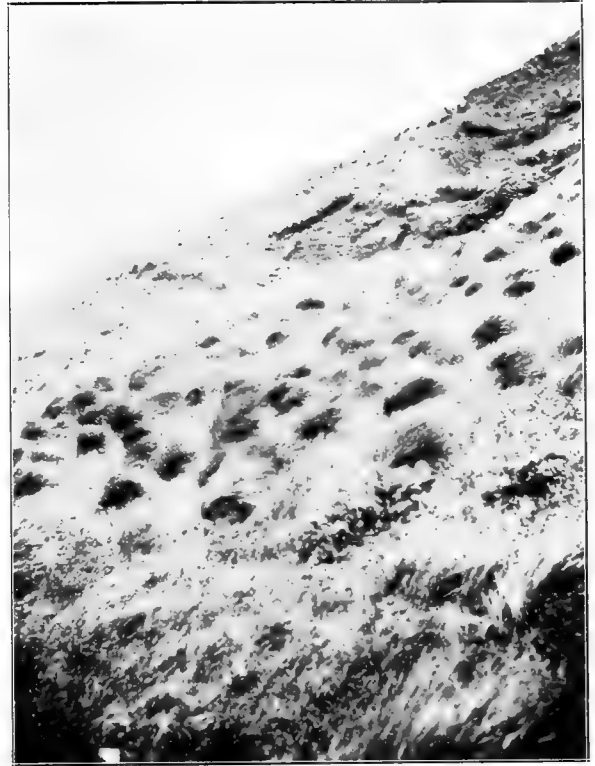
- | | |
|-----------------------------------|----------------------------------|
| 2248. <i>Oplismenus hirtellus</i> | 2249. <i>Paspalum orbiculare</i> |
|-----------------------------------|----------------------------------|

LIST OF NEW SPECIES AND NEW NAMES

- Aira nubigena** (Hillebr.) Hitchc.
Deschampsia nubigena Hillebr.
Calamagrostis hillebrandi (Munro) Hitchc.
Deyeuxia hillebrandi Munro
Calamagrostis expansa (Munro) Hitchc.
Deyeuxia expansa Munro
Cenchrus hillebrandianus Hitchc. sp. nov.
Eragrostis deflexa Hitchc. sp. nov.
Eragrostis leptophylla Hitchc. sp. nov.
Eragrostis mauiensis Hitchc. sp. nov.
Festuca hawaiiensis Hitchc. sp. nov.
Ischaemum byrone (Trin.) Hitchc.
Spodiopogon byronis Trin.
Panicum fauriei Hitchc. sp. nov.
Panicum forbesii Hitchc. sp. nov.
Panicum hillebrandianum Hitchc.
Panicum monticola Hillebr. Not *P. monticola* Hook. f.
Panicum kaalaense Hitchc. sp. nov.
Panicum kauaiense Hitchc. sp. nov.
Panicum lanaiense Hitchc.
Panicum affine Hook. & Arn. Not *P. affine* Poir.
Panicum xerophilum (Hillebr.) Hitchc.
Panicum nephelophilum xerophilum Hillebr.
Poa sandvicensis (Reichart) Hitchc.
Festuca sandvicensis Reichart
Poa section **Siphonocoleus** sect. nov.
Syntherisma chinensis (Nees) Hitchc.
Paspalum chinensis Nees
Syntherisma microbachne (Presl) Hitchc.
Panicum microbachne Presl



A. HAWAIIAN HUT THATCHED WITH PILI GRASS
(*HETEROPOGON CONTORTUS*).



B. *ERAGROSTIS VARIABILIS* AT NUUANU PASS.
A STRONG WIND IS BLOWING THROUGH THE PASS.



C. THE CENTRAL PLAIN OF OAHU AT SCHOFIELD BARRACKS. THE GRASS IN THE FORE-
GROUND IS MAINLY PILIPIPIULA (*RIAPHIS ACICULATA*). MOUNT
KAALA IN THE BACKGROUND AT THE RIGHT.



A. TIMBER LINE ON MAUNA KEA, HAWAII. *TRisetum GLOMERATUM* IN THE FOREGROUND.



B. MAUNA KEA NEAR TIMBER LINE. *AGROSTIS SANDWICENSIS* IN THE FOREGROUND AND *AIRA NUBIGENA* IN THE BACKGROUND. THE SHRUBS ARE MOSTLY MAMANI (*SOPHORA CHRYSOPHYLLA*).



A. A FIELD OF SUDAN GRASS (*HOLCUS SORGHUM SUDANENSIS*) AT THE UNITED STATES AGRICULTURAL EXPERIMENT SUBSTATION, HAIKU, MAUI.



B. GRAZING LAND. CENTRAL MOLOKAI.



A. A PLANTATION OF PASPALUM (PASPALUM DILATATUM), AN EXCELLENT PASTURE GRASS. AT THE UNITED STATES AGRICULTURAL EXPERIMENT SUBSTATION AT HAIKU, MAUI.



B. UBA CANE, A VARIETY OF SUGAR CANE GROWN FOR FORAGE. AT THE HAIKU STATION. IN THE BACKGROUND IS A FIELD OF PARA GRASS (PANICUM BARBINODE). CASTOR BEANS IN THE FOREGROUND.



A. POA SIPHONOGLOSSA AT KAHOLUAMANO, KAUAI. SOME OF THE STEMS ARE AS MUCH AS FIVE METERS LONG.



B. THE BASE OF A TUFT OF POA SIPHONOGLOSSA, SHOWING THE PECULIAR LEAFLESS SHEATHS.

A CONTRIBUTION TO TONGAN SOMATOLOGY

By LOUIS R. SULLIVAN

BASED ON THE FIELD STUDIES OF E. W. GIFFORD AND W. C. MCKERN

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Volume VIII—Number 4

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BAYARD DOMINICK EXPEDITION

PUBLICATION NUMBER 2

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1922

A CONTRIBUTION TO TONGAN SOMATOLOGY

By LOUIS R. SULLIVAN

Based on the field studies of E. W. Gifford and W. C. McKern

INTRODUCTION

THE somatological studies in Tonga followed the plan previously used for Samoa.¹ The field records were made by E. W. Gifford and W. C. McKern, assisted by Delila S. Gifford and show evidence of unusual care and discrimination; the mathematical computations were prepared by my wife, Bessie P. Sullivan. By arrangement between the American Museum of Natural History and the Bishop Museum the analysis of the data and the preparation of the results for publication constitute my share of the work.

Mr. Gifford and Mr. McKern call attention to the assistance rendered by many individuals in Tonga and especially to the kindness shown by Their Majesties Queen Charlotte Tupou and Prince Consort William Tungi, who permitted themselves to be measured, thus graciously setting an example that was gladly followed by their loyal subjects. The Privy Council also greatly aided the expedition by instructing the Minister of Police, Mr. Job Koho, to provide the required number of persons for each day's examinations.

The material on which this paper is based consists of complete descriptions and measurements of 225 persons, 121 men and 104 women. Of these 10 were of mixed racial descent and their records were therefore discarded. Of the remaining 215, 184 were adults more than twenty years of age and 31 adolescents. The averages of non-quantitative descriptions are based on observations of young and old from the age of sixteen upward; the averages of all measurements except stature are based on measurements of persons of both sexes eighteen years old and upward.

By nativity the individuals examined are distributed as follows: Niuatoputapu 4; Niuafuou 1; Vavau group 25; Haapai group 40 (in detail, Haano 8, Nomuka 2, Uiha 4, Lifuka 6, other places 20); Tongatabu 148 (Nukualofa 47, other places 101); Eua 5; elsewhere 2. The material was not consciously selected and represents persons of all social classes and occupations. It may be regarded as a fair qualitative sample of the Tongan people.

¹ Sullivan, L. A., A contribution to Samoan somatology: B. P. Bishop Mus. Mem. vol. viii, No. 2, 1921.

According to the Tongan census of 1920 there were at that time 23,128 Tongans in the group. Census returns for the past twenty years show that as a whole the Tongan population is increasing slowly. A temporary decrease was shown in the reports for 1918 and 1919, but returns for 1920 show a slight increase. It is of interest to notice also that there has been considerably less modern mixture with other races than in many other Polynesian groups. The census of 1917 records only 300 mixed bloods. How accurate this may be I do not know, but since the same census records only 347 Europeans and 529 other Pacific islanders, it is apparent that there have been fewer opportunities and temptations to marry outside the race than there have been in many other places where the aboriginal inhabitants are greatly outnumbered by the Europeans or Orientals. These facts should be borne in mind.

METHOD

All measurements were taken in accordance with the regulations of the International Agreement. The technique is described in some detail in my previous paper² but for the sake of convenience is here repeated in outline. Each measurement and index is numbered, and in the tables throughout this paper these numbers refer consistently to the same measurements.

ANTHROPOMETRIC CHARACTERS

1. Stature: recorded to the nearest centimeter (shoes removed).
2. Maximum head length: from the glabella to the opisthocranium.
3. Maximum head width.
4. Minimum frontal diameter: transverse.
5. Maximum face width or bizygomatic diameter.
6. Bigonial diameter at the angle of the mandible avoiding as much of the muscles as possible.
7. Anatomical face height; nasion to gnathion.
8. Nose height nasion to subnasale.
9. Nasal width; alare to alare.
10. Physiognomic ear length or height.
11. Physiognomic ear breadth.

INDICES

12. Cephalic or length-breadth index = $\frac{\text{measurement No. 3} \times 100}{\text{measurement No. 2}}$
13. Transverse fronto-parietal index = $\frac{\text{measurement No. 4} \times 100}{\text{measurement No. 3}}$
14. Transverse cephalo-facial index = $\frac{\text{measurement No. 5} \times 100}{\text{measurement No. 3}}$
15. Zygomatico-frontal index = $\frac{\text{measurement No. 4} \times 100}{\text{measurement No. 5}}$
(Sometimes designated as the jugo-frontal index)
16. Zygomatico-mandibular index = $\frac{\text{measurement No. 6} \times 100}{\text{measurement No. 5}}$
(Sometimes designated as the jugo-mandibular index)
17. Anatomical facial index = $\frac{\text{measurement No. 7} \times 100}{\text{measurement No. 5}}$
18. Nasal index = $\frac{\text{measurement No. 9} \times 100}{\text{measurement No. 8}}$
19. Physiognomic ear index = $\frac{\text{measurement No. 11} \times 100}{\text{measurement No. 10}}$

The anthropometric data were supplemented by observations on characters not quantitatively measurable. In view of the widespread misconception as to the nature of these characters and their value in somatology, it seems desirable to

² Op. cit.

point out in some detail just what has been attempted in describing characters that do not lend themselves readily to measurement. The fact that anthropologists have carelessly spoken of "types" of hair form, hair color, or eye color has given the erroneous impression—not only to the general reader but to many anthropologists as well—that these types actually exist in nature and that it is possible, for example, to arrange all human eyes in four, five, or six color groups. Although it is universally recognized that all characters that lend themselves to actual measurement show a continuous variation with a tendency for a large percentage of the individuals measured to cluster around a median or mean point, yet it is difficult to dislodge the idea that other characters such as color or form, which cannot be accurately measured with existing apparatus, have a discontinuous distribution. The body height or stature of the Scots, for example, ranges from 158 centimeters to 186 centimeters and averages about 172 centimeters. Very few Scotchmen are as short as 158 centimeters and very few are as tall as 186 centimeters. In progressing from the extremes towards the mean the number of individuals at each step increases. It is apparent to anyone who has endeavored to classify characters which do not lend themselves to measurement that in them he is dealing with exactly the same type of continuous variation. When the metric rod cannot be applied, standards are set up along the range of variation, separated widely enough to permit of distinguishing each from the standard preceding or following it, and an endeavor is made to classify the material on this basis. The attempt to classify all existing forms of hair as straight, low waves, deep waves, curly, frizzly, or woolly, produces results very similar to those which might be expected if the stature of all men were measured with a rod graduated in 10 centimeter intervals from 130 to 190 centimeters. A man's stature would be recorded as 130, 140, 150, 160, 170, 180, or 190 centimeters; yet it is obvious that the stature of many men would actually be 135, 136, or 137 centimeters. The rod is not graduated finely enough to record the true distribution of the measurements. In a sense hair classes may be compared with these 10-centimeter intervals. For example, straight hair might well correspond with the 130-centimeter mark and woolly hair with the 190-centimeter mark or vice versa. But at this point the analogy breaks down. It is not certain that low waves, deep waves, and other hair forms correspond exactly to the 140- and 150-centimeter points. Roughly they probably do. But by far the greatest difference in the two methods and one that should always be kept in mind in the analysis of data is that in the classification of these descriptive or attribute characters, so called, the "metric rod" exists only in the mind of the observer and is by no means a uniform or universal standard. This lack of a fixed standard makes difficult not only the comparison of small differences found by different observers, but also to a lesser extent those found at different times by the same observer. As the standard is purely visual, constructed largely upon the expe-

riences of each observer, it necessarily fluctuates constantly, varying with new experiences.

Despite the varying standards many of these non-measurable characters have proved to be of such great value in pointing out racial similarities and differences that no general somatological study is justified in omitting them. In pointing out the sources of error in data of this sort it is not my purpose to belittle their value or to imply that the size of the error is uniform for all characters. Although two observers might disagree as to whether a given sample of hair were low-waved, or straight, yet they would be much less likely to disagree as to whether it were straight or deeply waved, and still less likely to disagree as to whether it were straight or curly. The same considerations apply to color.

Recognizing then the fact of the continuous variation in these characters, I have described them as if they were discontinuous. For purposes of this paper hair form is classified as straight, low-waved, deep-waved, curly, frizzly, and woolly, and the color is designated as black, dark brown, reddish-brown, light brown, blond, golden, red, and gray. The amount of beard on the upper cheek, lower cheek, and chin and the amount of body hair on the chest, forearm, and leg was described as none, slight, medium, and heavy. Eye color is classified as black, dark brown, and light brown, blue, gray, blue-brown, and gray-brown. The amount of conjunctival pigment is classified roughly in accordance with the appearance of the sclera—white and clear, muddy, speckled, or mottled. The development or lack of development of the epicanthic (Mongoloid) eye fold is described as absent, slight, medium, or marked. The elevation of the nasal bridge has been

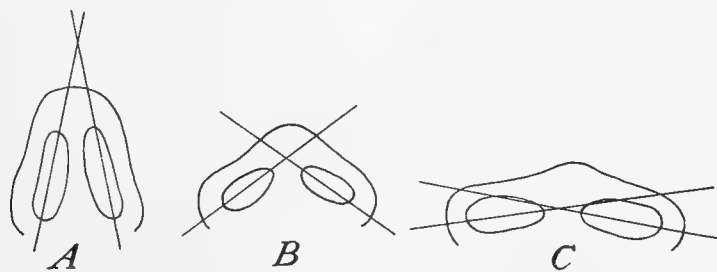


FIGURE 1. Diagram illustrating terminology used to describe the form of the nostrils: *A*, antero-posterior nostrils; *B*, obliquely placed nostrils; *C*, transverse nostrils.

estimated in terms of low, medium, or high. The form and direction of the nostrils are roughly classed, according to the direction of the long axis of each nostril, as antero-posterior, oblique, or transverse. (See figs. 1 and 2.) The slope of the forehead is estimated as vertical, moderate slope, or low. The development of the glabella is indicated by the terms smooth, medium, and prominent. The thickness

of the lips is recorded as thin, medium, or thick. Prognathism, which in a living person is a complex and somewhat elusive character, is described as absent, slight, medium, or marked. In the ears the development of the lobes (small or large, attached or separate), the roll of the helix (rolled one-third, two-thirds, three-thirds, or flat), and the presence or absence of Darwin's tubercle were recorded.

Particular care was taken to record the form of the upper incisor teeth with a view to determining the presence or absence of the shovel-shaped incisors. Although primarily described by Hrdlicka³ as shovel-shaped this condition of the incisor and other teeth has more recently been described by the same author as keilodonty and koilomorphy. As the fossa is dependent on the formation of the rim, it will be sufficiently clear and less cumbersome to discuss this condition in terms of rim development or keilodonty. In this paper classes of no rim, trace of rim, medium rim, and marked rim correspond to Hrdlicka's classes of no shovel, plain trace, semi-shovel, shovel-shaped. The condition is well described by Hrdlicka:⁴ "The lingual surface of the well developed shovel-shaped incisor is very striking. The usual moderate concavity from above downward is replaced by a triangular to rounded or oblong deep fossa. The base of the fossa is formed by the free edge of the tooth, its summit reaches upwards near to the gum. The fossa is bounded laterally and generally also distally, hence on all sides by a stout rim of enamel."

DESCRIPTION OF THE TONGANS

The results of the seriation and averages are summarized in Tables I, II, and III. In Table I we find a fairly normal distribution in all anthropometric characters. The number of persons concerned in each character is so small that any departure from the normal cannot be regarded too seriously. Doubling the class interval is usually sufficient to smooth the curve. Even after doing this, however, the distribution of head length and face width present a somewhat skewed distribution. Indications of bimodality are also noticeable in the bigonial diameter, face height, and face index distribution. At present the significance or non-significance of these facts is not clear.

³ Hrdlicka, Ales, Shovel-shaped teeth: *Am. Jour. of Phys. Anthr.*, vol. III, p. 429, 1920.

⁴ *Op. cit.*, p. 429.

TABLE I.—SERIATION OF ANTHROPOMETRIC CHARACTERS IN ABSOLUTE NUMBERS

1. STATURE			2. HEAD LENGTH			3. HEAD WIDTH			4. MINIMUM FRONTAL		
Centimeters	Male	Female	Millimeters	Male	Female	Millimeters	Male	Female	Millimeters	Male	Female
150	-----	1	170	-----	2	140	-----	1	90	-----	---
1	-----	0	1	-----	0	1	-----	1	1	-----	---
2	-----	1	2	-----	1	2	-----	2	2	1	---
3	-----	1	3	1	2	3	-----	2	3	0	1
4	-----	4	4	0	1	4	-----	6	4	2	1
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
5	-----	2	5	0	1	5	1	7	5	1	3
6	-----	1	6	1	2	6	2	9	6	2	0
7	-----	5	7	0	6	7	2	7	7	2	4
8	-----	4	8	0	4	8	5	5	8	1	5
9	-----	6	9	0	5	9	3	9	9	3	11
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
160	1	7	180	0	6	150	6	8	100	8	7
1	1	7	1	2	5	1	6	8	1	4	7
2	0	7	2	9	4	2	6	4	2	10	7
3	0	6	3	4	12	3	10	2	3	11	7
4	1	4	4	5	4	4	13	6	4	14	7
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
5	5	5	5	2	2	5	12	9	5	14	10
6	3	4	6	9	4	6	15	0	6	8	5
7	5	3	7	5	9	7	7	3	7	5	5
8	1	2	8	4	3	8	8	2	8	6	4
9	5	6	9	7	5	9	6	1	9	3	4
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
170	9	1	190	10	2	160	5	0	110	7	1
1	3	3	1	9	4	1	2	2	11	4	2
2	7	2	2	5	0	2	4	1	12	2	1
3	6	2	3	7	4	3	1	1	13	1	0
4	10	1	4	5	1	4	1	0	14	2	4
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
5	4	0	5	4	4	5	0	1	15	3	---
6	8	0	6	3	1	6	0	---	16	1	---
7	8	0	7	4	1	7	2	---	17	0	---
8	3	0	8	2	1	8	-----	---	18	0	---
9	3	0	9	7	0	9	-----	---	19	1	---
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
180	2	0	200	1	0	170	-----	---	Total	116	96
1	4	0	1	2	1	1	-----	---			
2	1	1	2	2	---	2	-----	---			
3	1	---	3	0	---	3	-----	---			
4	0	---	4	4	---	4	-----	---			
-----	-----	-----	-----	-----	-----	-----	-----	-----			
5	0	---	5	1	---	Total	117	97			
6	0	---	6	0	---						
7	0	---	7	0	---						
8	1	---	8	0	---						
9	0	---	9	0	---						
-----	-----	-----	-----	-----	-----						
Total	92	88	210	1	---						
			11	0	---						
			12	0	---						
			13	1	---						
			14	-----	---						
			Total	117	97						

5. FACE WIDTH			6. BIGONIAL			7. FACE HEIGHT			8. NOSE HEIGHT		
Millimeters	Male	Female	Millimeters	Male	Female	Millimeters	Male	Female	Millimeters	Male	Female
120	----	---	90	----	3	100	----	---	40	----	---
1	----	---	1	----	2	1	----	---	1	----	---
2	----	1	2	1	3	2	----	---	2	----	---
3	----	0	3	1	4	3	----	---	3	----	---
4	----	1	4	2	2	4	----	1	4	----	---
5	----	0	5	4	3	5	----	0	5	----	---
6	----	1	6	2	10	6	----	0	6	----	---
7	----	1	7	1	11	7	----	0	7	1	---
8	----	2	8	2	3	8	----	0	8	2	---
9	----	1	9	6	7	9	----	0	9	0	3
130	----	6	100	9	14	110	----	0	50	2	2
1	2	5	1	7	7	11	----	0	1	0	2
2	2	4	2	10	5	12	2	0	2	5	6
3	4	6	3	8	4	13	0	0	3	5	6
4	0	6	4	9	4	14	0	2	4	7	7
5	3	5	5	4	3	15	1	1	5	15	9
6	1	6	6	5	5	16	0	3	6	15	15
7	1	10	7	4	4	17	1	5	7	13	9
8	7	10	8	9	0	18	3	2	8	6	7
9	8	3	9	5	0	19	6	11	9	7	7
140	8	3	110	5	0	120	6	5	60	11	10
1	9	6	11	8	1	1	7	0	1	7	6
2	11	4	12	3	0	2	3	7	2	9	3
3	7	2	13	2	0	3	2	8	3	5	1
4	6	4	14	1	0	4	4	7	4	4	0
5	7	3	15	4	1	5	6	7	5	2	2
6	6	2	16	2	---	6	2	6	6	---	1
7	8	0	17	0	---	7	6	2	7	---	1
8	2	0	18	1	---	8	9	11	8	---	---
9	7	2	19	1	---	9	5	3	9	---	---
150	4	0	Total	116	96	130	8	5	Total	117	97
1	2	1				1	7	3			
2	3	1				2	8	2			
3	2	0				3	6	1			
4	1	1				4	6	1			
5	1	---				5	6	1			
6	0	---				6	2	0			
7	1	---				7	2	1			
8	1	---				8	1	0			
9	2	---				9	1	1			
Total	116	97				140	2	1			
						1	0	---			
						2	1	---			
						3	1	---			
						4	0	---			
						5	1	---			
						6	0	---			
						7	1	---			
						8	---	---			
						9	---	---			
						Total	116	97			

9. NOSE WIDTH			10. EAR HEIGHT			11. EAR WIDTH			12. CEPHALIC INDEX		
Millimeters	Male	Female	Millimeters	Male	Female	Millimeters	Male	Female	Index	Male	Female
30	.....	....	50	.....	....	20	.....	....	70	.....	....
1	.....	....	1	.....	....	1	.....	....	1	.....	....
2	.....	....	2	.....	....	2	.....	....	2	.....	....
3	.....	....	3	.....	....	3	.....	....	3	1	....
4	.....	....	4	.....	....	4	.....	....	4	2	2
5	.....	....	5	.....	....	5	1	....	5	0	2
6	.....	1	6	2	1	6	0	....	6	5	8
7	.....	4	7	2	1	7	0	....	7	3	4
8	1	10	8	2	2	8	1	....	8	10	8
9	7	6	9	2	3	9	1	3	9	15	8
40	3	10	60	3	9	30	5	9	80	19	9
1	9	11	1	2	8	1	4	7	1	13	10
2	12	15	2	14	6	2	7	19	2	12	9
3	10	13	3	8	13	3	18	12	3	14	9
4	22	10	4	13	9	4	25	18	4	6	5
5	15	5	5	9	12	5	13	11	5	6	4
6	9	6	6	9	5	6	16	11	6	3	6
7	10	3	7	12	6	7	10	2	7	4	4
8	8	2	8	11	6	8	9	2	8	2	4
9	6	0	9	4	3	9	3	2	9	2	2
50	3	1	70	7	5	40	2	0	90	.....	0
1	1	....	1	4	2	1	0	1	1	.....	2
2	0	....	2	5	2	2	1	....	2	.....	1
3	0	....	3	0	2	3	.....	....	3	.....	....
4	0	....	4	1	1	4	.....	....	4	.....	....
5	1	....	5	4	1	5	.....	....	5	.....	....
6	.....	....	6	0	....	6	.....	....	.....	.....	....
7	.....	....	7	1	....	7	.....	....	.....	.....	....
8	.....	....	8	0	....	8	.....	....	.....	.....	....
9	.....	....	9	1	....	9	.....	....	.....	.....	....
Total	117	97	80	1	....	Total	116	97	Total	117	97
			1	.....	....				
			2	.....	....				
			3	.....	....				
			4	.....	....				
			5	.....	....				
			Total	117	97						

13. FRONTO-PARIETAL			14. CEPHALO-FACIAL			15. ZYGOMATICO-FRONTAL			16. ZYGOMATICO-MANDIBULAR		
Index	Male	Female	Index	Male	Female	Index	Male	Female	Index	Male	Female
55	-----	----	80	-----	----	60	-----	----	60	-----	----
6	-----	----	1	-----	----	1	-----	----	1	-----	----
7	-----	----	2	-----	----	2	-----	----	2	-----	----
8	-----	----	3	-----	----	3	3	-----	3	1	----
9	2	----	4	-----	2	4	0	----	4	2	3
<hr/>			<hr/>			<hr/>			<hr/>		
60	1	----	5	1	2	5	1	----	5	3	----
1	2	1	6	2	3	6	4	1	6	1	2
2	4	1	7	2	5	7	2	0	7	4	3
3	3	2	8	6	10	8	6	1	8	4	4
4	6	6	9	6	9	9	3	1	9	7	7
<hr/>			<hr/>			<hr/>			<hr/>		
5	11	2	90	13	9	70	14	3	70	7	9
6	17	15	1	14	11	1	6	3	1	12	13
7	9	11	2	19	8	2	15	9	2	10	8
8	14	10	3	8	11	3	10	11	3	11	9
9	12	12	4	15	14	4	11	7	4	17	9
<hr/>			<hr/>			<hr/>			<hr/>		
70	11	8	5	4	3	5	9	15	5	6	11
1	10	12	6	6	4	6	8	15	6	5	4
2	7	5	7	10	5	7	5	10	7	10	6
3	4	3	8	2	0	8	5	6	8	4	4
4	2	6	9	4	0	9	6	3	9	2	5
<hr/>			<hr/>			<hr/>			<hr/>		
5	0	0	100	2	1	80	5	5	80	0	----
6	0	2	1	0	----	1	0	3	1	5	----
7	0	1	2	1	----	2	1	2	2	1	----
8	0	----	3	1	----	3	1	1	3	1	----
9	0	----	4	-----	----	4	1	0	4	0	----
<hr/>			<hr/>			<hr/>			<hr/>		
80	0	----	Total	116	97	5	-----	0	5	1	----
1	0	----				6	-----	1	6	1	----
2	1	----				7	-----	----	7	1	----
3	-----	----				8	-----	----	8	-----	----
4	-----	----				9	-----	----	9	-----	----
<hr/>			<hr/>			<hr/>			<hr/>		
Total	116	97				Total	116	97	Total	116	97

17. ANATOMICAL FACE
HEIGHT

Index	Male	Female
70	----	----
1	----	----
2	----	----
3	----	----
4	----	----
<hr/>		
5	----	----
6	----	----
7	----	----
8	2	----
9	0	----
<hr/>		
80	2	----
1	2	----
2	2	----
3	2	1
4	6	1
<hr/>		
5	3	5
6	10	9
7	14	5
8	5	9
9	11	11
<hr/>		
90	13	8
1	9	9
2	10	10
3	4	6
4	10	5
<hr/>		
5	2	5
6	5	4
7	2	2
8	----	1
9	----	0
<hr/>		
100	----	0
1	----	2
2	2	2
3	----	0
4	----	----
<hr/>		
5	----	----
6	----	0
7	----	1
8	----	----
9	----	----
<hr/>		
Total	116	97

18. NASAL INDEX

Index	Male	Female
60	----	----
1	1	----
2	0	----
3	1	----
4	1	2
<hr/>		
5	2	1
6	5	7
7	0	4
8	5	7
9	2	1
<hr/>		
70	4	8
1	6	11
2	2	5
3	6	6
4	3	3
<hr/>		
5	6	5
6	6	5
7	7	4
8	5	3
9	8	3
<hr/>		
80	10	5
1	7	3
2	7	4
3	2	1
4	4	3
<hr/>		
5	2	1
6	1	0
7	4	3
8	1	1
9	3	1
<hr/>		
90	0	----
1	2	----
2	1	----
3	0	----
4	0	----
<hr/>		
5	0	----
6	1	----
7	0	----
8	1	----
9	----	----
<hr/>		
100	----	----
106	1	----
<hr/>		
Total	117	97

19. EAR INDEX

Index	Male	Female
40	1	----
1	0	----
2	1	----
3	0	1
4	1	0
<hr/>		
5	1	2
6	2	6
7	5	4
8	5	9
9	9	9
<hr/>		
50	11	7
1	10	4
2	16	16
3	11	10
4	9	8
<hr/>		
5	6	5
6	13	5
7	4	3
8	3	1
9	1	3
<hr/>		
60	5	2
1	2	1
2	----	0
3	----	1
<hr/>		
Total	116	97

TABLE II.—SUMMARY OF ANTHROPOMETRIC CHARACTERS OF TONGANS

CHARACTER	MALE				FEMALE			
	92 to 117 persons				88 to 97 persons			
	Average	E ^a	S. D.	V	Average	E ^a	S. D.	V
1 Stature	173.0	.54	5.21	3.01	162.5	.62	5.83	3.58
2 Head length.....	191.0	.63	6.89	3.60	184.1	.65	6.47	3.51
3 Head width.....	154.8	.39	4.26	2.75	150.0	.51	5.06	3.37
4 Min. frontal.....	104.8	.45	4.87	4.64	103.0	.47	4.65	4.51
5 Face width.....	143.5	.55	5.94	4.13	136.1	.61	6.03	4.43
6 Bigonial	104.8	.54	5.81	5.54	99.2	.49	4.80	4.83
7 Face height.....	128.2	.63	6.81	5.31	124.1	.58	5.79	4.66
8 Nose height.....	57.5	.36	3.91	6.80	56.7	.38	3.75	6.61
9 Nose width.....	44.4	.27	3.02	6.80	41.9	.29	2.86	6.82
10 Ear height.....	66.0	.42	4.57	6.92	64.5	.40	3.97	6.15
11 Ear width.....	34.5	.24	2.62	7.59	33.4	.23	2.35	7.03
12 Cephalic index.....	81.1	.29	3.14	3.87	81.6	.41	4.09	5.01
13 Fronto-parietal index.....	67.6	.32	3.51	5.19	68.7	.32	3.22	4.68
14 Cephalo-facial index.....	92.8	.43	4.68	5.04	91.2	.32	3.23	3.54
15 Zygomatico-frontal index.....	73.1	.39	4.23	5.78	75.4	.33	3.33	4.41
16 Zygomatico-mandibular index.....	73.2	.42	4.56	6.22	72.5	.36	3.57	4.92
17 Facial index.....	89.2	.41	4.43	4.96	90.8	.43	4.32	4.75
18 Nasal index.....	77.6	.70	7.58	9.76	74.2	.62	6.15	8.28
19 Ear index.....	52.4	.36	3.93	7.50	51.8	.39	3.93	7.58

^a In this table E = probable error of the average, S. D. = standard deviation, and V = coefficient of variation in percentage.

TABLE III.—SUMMARY OF ATTRIBUTE CHARACTERS OF TONGANS

CHARACTER	MALE		FEMALE	
	Von Luschan's scale			
Skin Color:				
Unexposed	Nos. 14, 15, 16		Nos. 13, 14, 15, 16	
Exposed	Nos. 15, 16, 17, 18, 22, 23		Nos. 15, 16, 17, 18, 22	
Hair form:	Number	Per cent	Number	Per cent
Straight	49	41.5	33	34.4
Low waves.....	49	41.5	45	46.9
Deep waves.....	17	14.4	12	12.5
Curly	3	2.5	5	5.2
Frizzly	0	0	1	1.0
Woolly	0	0	0	0
Totals	118		96	
Hair color:	Number	Per cent	Number	Per cent
Black	111	94.1	85	87.6
Dark brown	5	4.2	4	4.1
Reddish brown	1 ^a	.8	7 ^a	7.2
Light brown.....	0	0	0	0
Blond	0	0	0	0
Golden	0	0	0	0
Red	1 ^a	.8	0	0
Gray	0	0	1	1.0
Totals	118		97	

^a Bleached with lime.

CHARACTER		MALES ONLY		
Amount of Beard:		Upper cheek	Lower cheek	Chin
None		2.1	4.2	0
Scant		15.8	37.2	19.4
Medium		33.7	18.1	30.6
Heavy		48.4	40.4	50.0
Amount of body hair:		On chest	On forearm	On legs
None		23.4	0	0
Scant		28.7	10.5	7.3
Medium		25.5	43.2	66.7
Heavy		22.3	46.3	26.0
		MALE		FEMALE
Eye color:	Number	Per cent	Number	Per cent
Black	4	3.4	15	15.5
Dark brown	111	94.1	79	81.4
Light brown	3	2.5	2	2.1
Blue	0	0	1	1.0
Gray	0	0	0	0
Blue-brown	0	0	0	0
Gray-brown	0	0	0	0
Total	118		97	
Conjunctiva	Number	Per cent	Number	Per cent
Clear	22	18.8	41	42.7
Not clear	95	81.2	55	57.3
Total	117		96	
Epicanthic eye fold	Number	Per cent	Number	Per cent
Absent	63	56.8	52	53.6
Trace	33	29.7	26	26.8
Medium	9	8.1	14	14.4
Marked	6	5.4	5	5.2
Total	111		97	
Nasal bridge	Number	Per cent	Number	Per cent
Low	21	21.7	29	30.5
Medium	81	70.4	64	67.4
High	9	7.8	2	2.1
Total	111		95	
Axes of nostrils ^a	Number	Per cent	Number	Per cent
Anterior-posterior	2	1.7	5	5.3
Oblique	90	78.3	66	69.5
Transverse	23	20.0	24	25.3
Total	115		95	
Slope of forehead	Number	Per cent	Number	Per cent
Vertical	70	60.3	81	84.4
Moderate	45	38.8	15	15.6
Low	1	.9	0	0
Total	116		96	

^a See figs. 1 and 2.

CHARACTER	MALE		FEMALE	
	Number	Per cent	Number	Per cent
Glabella				
Smooth	55	49.1	81	83.5
Medium	48	42.8	15	15.5
Prominent	9	8.0	1	1.0
Total	112		97	
Lips	Number	Per cent	Number	Per cent
Thin	12	10.3	10	10.3
Medium	97	83.6	85	87.6
Thick	7	6.0	2	2.1
Total	116		97	
Prognathism	Number	Per cent	Number	Per cent
None	63	53.3	45	46.4
Slight	26	22.0	36	37.1
Medium	29	24.6	15	15.5
Marked	0	0	1	1.0
Total	118		97	
Ear lobe	Number	Per cent	Number	Per cent
None	5	4.3	2	2.1
Small separate	48	41.7	37	38.5
Small attached	48	41.7	44	45.8
Large separate	9	7.8	8	8.3
Large attached	5	4.3	5	5.2
Total	115		96	
Helix roll	Number	Per cent	Number	Per cent
Flat	0	0	2	2.1
Rolled first $\frac{1}{3}$	20	16.1	34	35.4
Rolled first $\frac{2}{3}$	67	56.8	48	50.0
Rolled throughout	31	26.3	12	12.5
Total	118		96	
Darwin's tubercle	Number	Per cent	Number	Per cent
Present	25	21.4	5	5.2
Keilodonty	Number	Per cent	Number	Per cent
Lateral incisor teeth				
No rim	48	42.1	33	36.3
Trace of rim	49	42.9	37	40.6
Medium rim {	17	14.9	21	23.1
Marked rim {				
Mesial incisor teeth				
No rim	66	57.9	57	62.6
Trace of rim	34	29.8	24	26.4
Medium rim {	14	12.3	10	10.9
Marked rim {				
Total	114		91	

The results summarized in Tables II and III show that the Tongans are among the tallest groups of mankind. The men average 173 centimeters or about 5 feet 8 inches in height. On the average the women are 10 centimeters, or 4 inches, shorter. The head is both long and broad yielding an average index of 81.1 for the men and 81.6 for the women. There is no assurance, however, that these are the natural diameters of the Tongan head. In the skeletal material brought back by Gifford and McKern, seven crania were in a fair state of preservation. With the single exception of one cranium of a young child all of these crania showed a moderate to a pronounced degree of occipital flattening accompanied by marked asymmetry, pointing clearly to the fact that they had been artificially deformed. The cranial length-breadth indices were 82.7, 84.5, 86.0, 86.0, 88.2, and 93.7. These average 86.8.

At my request inquiries were made by Gifford and McKern as to the prevalence and methods of head deformation. The information shows that the Tongans in the past and to some extent at the present time shape the heads of children, but the description of the methods employed throws no light on the deformation seen in the crania. According to several informants the child was laid on a piece of tapa with the top of its head placed against a heavy block of squared wood, the pressure tending to flatten the top of the cranium. The deformation described above is decidedly not of this type. Since this procedure is said to have been continued for one month only, its effect may be considered as negligible. It is difficult to understand how it would have any appreciable effect even if continued indefinitely, since the amount of pressure involved must have been very slight.

In the Tongan skeletal material that I examined, the tops of the crania show no evidences of flattening. The deformation on these Tongan crania is very similar to that observed in the crania of many groups of Indians in the southwestern United States. Occipital flattening is usually thought to be accidental—at least in origin. When the effect of it was once recognized, conscious effort may have been made in certain groups to duplicate by artificial means the results obtained by accident. The hard beds and wooden pillows that are still in use among the Tongans suggest a possible explanation of the occipital flattening, as it is known that a certain amount of deformation or flattening is easily brought about by hard pillows, particularly in persons who are naturally short headed. Examples of such accidental flattening of the occiput are numerous among the Chinese, Japanese, and Koreans. The only difficulty involved in this explanation is to account for the difference between the degree of deformation found in the living series and that in the cranial series. It is known that the crania are not modern. The average length-breadth index of these crania is nearly 6 points higher than the same index in the living. On the whole, while the implication is that deformation is not so prevalent at present as in the past, it seems better to base no generalization on the

form of the head. Directly or indirectly, minimum frontal diameter, transverse fronto-parietal index and cephalo-facial index would also be somewhat altered in persons with deformed occiputs. On account of the very close correspondence of Tongans and Samoans in cephalic index it is obvious that this caution should be extended to the Samoan data⁵ as well.

The transverse and vertical diameters of the Tongan face and its component parts are so large that the face and nose may both well be described as massive. The skin is a medium yellowish-brown where it is unexposed to wind and sun.



FIGURE 2. Tongan nostrils arranged roughly according to the orientation of the axes. Photographs by Gifford and McKern.

Exposed parts of the skin of a few of the persons were a very dark chocolate-brown. The hair may be described as black, of medium coarseness, and either straight or slightly waved. The beard is moderately developed and the amount of body-hair on the chest, arms, and legs may also be described as somewhat below the average. The eyes are dark brown in color and a considerable amount of conjunctival pigment is normal. The epicanthic eye fold is typically absent, but nearly 30 per cent showed what is termed a "trace" of this fold, and a few marked examples of it were noted.

⁵ B. P. Bishop Mus. Mem. vol. VIII, No. 2, 1921.

The eyes of Tongans as a group are less wide open than are the eyes of Caucasian peoples. The types illustrated in Nos. 3, 4, 5, and 6 in Plate xxxvi, *A*, are most common. They are characterized by being placed somewhat obliquely with just a suggestion of an epicanthic fold, and by a slightly thickened and bevelled lower lid. No. 8 has a well-marked epicanthic fold and No. 7 a definite trace of it.

The nose of the Tongan is worthy of some detailed description and comparison. As judged by the standard of the European nose the nasal bridge of Tongans cannot be said to be highly arched. (See Pl. xxxviii, *A* and *B*.) It is prevailingly of medium or low elevation from the face. The nostrils are somewhat oval in shape with the long axis tending to run in an oblique or transverse direction.

Although, as expressed by the nasal index, the Tongan has what is usually termed a moderately broad or mesorrhine nose, yet by absolute measurement the nasal width is exceeded only by that of a few Negroid groups. (See Pls. xxxvi and xxxix.) In Table IV I have given some comparative data on the range of the nasal index for given widths of nose. It is not at all unusual to find groups with identical nasal widths varying by 20 points in nasal index. This leads me to believe that unless the absolute diameters are somewhat nearly alike in two groups a correspondence in nasal index should not be taken too seriously. The enormous proportions of the Tongan (and also of the Samoan) nose are approached only by certain American Indian groups. The Tongans, the Samoans, the Chippewa Indians, the Egyptians, the Ilokos, the Kirghez, the Khotan, and the Polish Jews have nasal indices averaging from 72.6 to 78.0. Does it follow that their noses are very similar? Not at all. In some cases the low nasal index is the result of the great height of the nose and in spite of the great width. This is true of the Tongans, Samoans, and Chippewa Indians. In the others it is due to the fact that the noses are of moderate width and height. So it seems that the use of the nasal index should at least be supplemented by absolute measurements.

TABLE IV. COMPARISON OF NASAL WIDTH, NASAL HEIGHT, AND NASAL INDICES ARRANGED IN ORDER OF MAGNITUDE OF NASAL WIDTH.

GROUP	NASAL WIDTH	NASAL HEIGHT	NASAL INDEX	AUTHOR
Kajji, Nigeria	45.0	49.0	91.0	Tremearne
Mawambi pygmy	45.0	.....	.....	Martin
Tonga	44.4	57.5	77.6	Sullivan
Toricelli, New Guinea	44.3	.....	.....	Martin
Fan	44.0	48.0	91.1	Martin
Kagoro, Nigeria	44.0	47.0	92.9	Tremearne
Sentani, New Guinea	44.0	49.0	87.9	Van der Sande
Humboldt Bay, New Guinea	44.0	53.0	83.7	Van der Sande
Samoa	43.8	59.8	73.6	Sullivan
Shoshoni Amerindian	43.4	52.2	83.1	Boas
Chippewa Amerindian	42.8	56.5	75.5	Irdlicka
Negrito, Zambales	42.8	40.5	106.0	Reed
Maricopa Amerindian	41.4	49.0	85.2	Ten Kate
Tagalog Bulakan	41.0	50.0	82.0	Folkmar
Tagalog, Rizal	41.0	51.0	80.5	Folkmar
Bisaya Iloilo	41.0	49.0	84.1	Folkmar
Nahuqua Amerindian	40.5	.....	.....	Martin
Iloko, Ilokos Norte	40.0	55.0	73.1	Folkmar
Senoi	40.0	47.0	85.0	Martin
Dolan, Turkestan	39.9	51.2	78.9	Joyce
Subanun	39.9	52.6	74.8	Christie
Sioux Amerindian	39.9	58.3	68.8	Sullivan
Sundanese	39.0	45.1	86.9	Garrett
Banjerese	38.8	44.3	88.0	Garrett
Kirghiz	38.2	49.3	78.1	Joyce
Dombs, India	38.0	44.0	86.5	Fawcett
Aino	38.0	55.9	68.0	Koganei
Nabaloi, Benguet	38.0	40.0	95.0	Bean
South Andamanese	37.7	42.7	88.2	Martin
Egyptian	37.3	48.7	76.6	Martin
Polish Jew	37.0	51.0	72.6	Fishberg
Little Russian Jew	37.0	53.0	69.8	Fishberg
Khotan, Turkestan	36.9	49.9	74.7	Joyce

The forehead of the Tongan is well developed and presents a rather gradual slope. The glabella is developed only to a moderate degree. Though the lips are designated as of medium thickness (Pl. xxxvi, *B*), it is obvious that if our standards were more sensitive we should find that they were somewhat above the average in thickness. As a group the Tongans are not prognathous. However it is safe to say that the face is more projecting than that of the European. The chin is positive but not so prominent a feature as that of Europeans. (See Pl. xxxvii, *A* and xxxvii, *B*.) The ears are large but offer no points of special interest. The rim on the lingual surface of the upper incisor teeth is typically not well developed. It was noticed, however, in what may be termed a moderate degree of frequency.

COMPARISON OF THE TONGANS WITH THE SAMOANS

Researches during the past year provide the necessary data for a comparison of the Tongans and the Samoans, and it is practicable to make the comparison somewhat more detailed than is usual, because both groups were studied by the same men, and differences in method and technique can therefore be largely ignored.

In Table V the standard deviations and coefficients of variation are compared. The Samoan series is somewhat noteworthy for its relative homogeneity when compared with existing groups of man. As a group the Tongans show noticeably more variation than the Samoans. In thirteen of the nineteen characters under discussion the Tongans are more variable than the Samoans—a statement which applies to both sexes. In the six characters in which the Samoans exceed the Tongans in range, the excess is very slight. In most of the characters in which the Tongans are the more variable the excess is appreciably larger. In both groups the variability as expressed by the coefficient of variation is considerably greater in the males than in the females.

In comparing the averages of the two groups for each anthropometric character shown in Table VI and the frequencies of the attribute characters shown in Table VII, the very close correspondence of the Tongans to the Samoans is striking in every character that lends itself to accurate measurement. Most of the differences occurring might well be regarded as chance differences. It must be remembered again that small differences in distribution in the attribute or descriptive characters are not to be taken too seriously.

TABLE V. COMPARISON OF STANDARD DEVIATIONS AND COEFFICIENTS OF VARIATION IN SAMOAN AND TONGAN SERIES

CHARACTER	MALE				FEMALE			
	S. D. \pm		V. in per cent		S. D. \pm		V. in per cent	
	Samoan	Tongan	Samoan	Tongan	Samoan	Tongan	Samoan	Tongan
1. Stature	5.25	5.21	3.05	3.01	4.92	5.83	3.05	3.58
2. Head length	5.69	6.89	2.98	3.60	5.22	6.47	2.85	3.51
3. Head width	4.46	4.26	2.88	2.75	3.87	5.06	2.61	3.37
4. Minimum frontal	5.98	4.87	5.78	4.64	3.96	4.65	3.90	4.51
5. Face width	5.23	5.94	3.59	4.13	3.79	6.03	2.77	4.43
6. Bigonial	5.13	5.81	4.90	5.54	3.93	4.80	3.96	4.83
7. Face height	6.56	6.81	5.00	5.31	6.41	5.79	5.30	4.66
8. Nose height	3.64	3.91	6.09	6.80	4.53	3.75	8.34	6.61
9. Nose width	2.59	3.02	5.91	6.80	2.56	2.86	6.21	6.82
10. Ear height	4.23	4.57	6.39	6.92	3.33	3.97	5.44	6.15
11. Ear width	2.76	2.62	7.84	7.59	2.30	2.35	6.84	7.03
12. Cephalic index	3.53	3.14	4.34	3.87	2.98	4.09	3.68	5.01
13. Fronto-parietal index	3.30	3.51	4.94	5.19	3.12	3.22	4.54	4.68
14. Cephalo-facial index	2.84	4.68	3.01	5.04	2.63	3.23	2.84	3.54
15. Zygomatico-frontal index	3.55	4.23	5.01	5.78	3.34	3.33	4.49	4.41
16. Zygomatico-mandibular index	3.84	4.56	5.42	6.22	3.50	3.57	4.83	4.92
17. Facial index	4.87	4.43	5.42	4.96	5.03	4.32	5.60	4.75
18. Nasal index	5.86	7.58	7.96	9.76	7.99	6.15	10.47	8.28
19. Ear index	3.79	3.93	7.11	7.50	4.53	3.93	8.25	7.58

TABLE VI. COMPARISON OF AVERAGES OF ANTHROPOMETRIC CHARACTERS OF TONGANS AND SAMOANS

CHARACTER	MALE				FEMALE		
	1	2	3	4	5	6	7
	A ₁	A ₂	A ₁ -A ₂	$\sqrt{e_1^2 + e_2^2}$	A ₁	A ₂	A ₁ -A ₂
	Samoan 67-70 Persons	Tongan 92-117 Persons			Samoan 20-23 Persons	Tongan 88-97 Persons	
1. Stature	171.7	173.0	+ 1.3	.83	161.2	162.5	+ 1.3
2. Head length	190.6	191.0	+ 0.4	.93	183.0	184.1	+ 1.1
3. Head width	154.8	154.8	0.0	.67	148.1	150.0	+ 1.9
4. Minimum frontal	103.4	104.8	+ 1.4	.85	101.5	103.0	+ 1.5
5. Face width	145.9	143.5	- 2.4 ²	.84	136.5	136.1	- 0.4
6. Bigonial	104.6	104.8	+ 0.2	.82	99.0	99.2	+ 0.2
7. Face height	131.1	128.2	- 2.9 ²	1.01	121.1	124.1	+ 3.0
8. Nose height	59.8	57.5	- 2.3 ¹	.56	54.3	56.7	+ 2.4
9. Nose width	43.8	44.4	+ 0.6	.41	41.2	41.9	+ 0.7
10. Ear height	66.1	66.0	- 0.1	.65	61.2	64.5	+ 3.3
11. Ear width	35.2	34.5	- 0.7	.41	33.6	33.4	- 0.2
12. Cephalic index	81.3	81.1	- 0.2	.51	80.8	81.6	+ 0.8
13. Fronto-parietal index	66.8	67.6	+ 0.8	.51	68.8	68.7	- 0.1
14. Cephalo-facial index	94.2	92.8	- 1.4 ²	.55	92.4	91.2	- 1.2
15. Zygomatico-frontal index	70.9	73.1	+ 2.2 ¹	.58	74.5	75.4	+ 0.9
16. Zygomatico-mandibular index	71.7	73.2	+ 1.5	.62	72.5	72.5	0.0
17. Facial index	89.9	89.2	- 0.7	.72	89.8	90.8	+ 1.0
18. Nasal index	73.6	77.6	+ 4.0 ¹	.99	76.3	74.2	- 2.1
19. Ear index	53.3	52.4	- 0.9	.58	54.9	51.8	- 3.1

In Table VI the Samoan male averages are given in column 1 and the Tongan male averages in column 2. The differences of the two averages with the Samoans as a standard are given in column 3, superior figure 1 indicating possible significant difference and superior figure 2 an approach to significant difference. These differences are compared with the magnitude of the errors of the averages in column 4. Unless a difference in column 3 is three times as great as the magnitude of the errors in column 4, it is not regarded as significant. Columns 5, 6, and 7 give the same data for the females as are given in columns 1, 2, and 3 for males. The differences in the females are less significant on account of the size of the Samoan sample.

TABLE VII. COMPARISON OF ATTRIBUTE CHARACTERS IN TONGANS AND SAMOANS ON A PERCENTAGE BASIS

CHARACTER	MALE		FEMALE	
	Samoan	Tongan	Samoan	Tongan
	67-70	92-118	20-23	88-97
	Persons	Persons	Persons	Persons
Skin color	Medium	Medium	Medium	Medium
(unexposed part).....	brown	brown	brown	brown
Von Luschan's numbers.....	14, 15, 16	14, 15, 16, 17	13, 14, 15	13, 14, 15, 16

CHARACTER	MALE		FEMALE	
	Samoa	Tongan	Samoa	Tongan
Hair form				
Straight	55.1	41.5	47.8	34.4
Low waves	27.5	41.5	39.1	46.9
Deep waves	10.1	14.4	8.8	12.5
Curly	5.8	2.5	0	5.2
Frizzly	1.4	0	4.3	1.0
Woolly	0	0	0	0
Hair color				
Black	91.4	94.1	56.9	87.6
Dark brown	4.3	4.2	8.8	4.1
Amount of hair—males only	UPPER CHEEK		CHIN	
None	10.1	2.1	0	0
Scant	46.3	15.8	23.2	19.4
Medium	31.9	33.7	27.5	30.6
Heavy	11.5	48.4	49.2	50.0
	LOWER CHEEK		CHEST	
None	14.5	4.2	59.7	23.4
Scant	43.3	37.2	22.3	28.7
Medium	23.2	18.1	14.9	25.5
Heavy	18.8	40.4	3.0	22.3
	FOREARM		LEG	
None	3.0	0	0	0
Scant	19.1	10.5	7.2	7.3
Medium	35.3	43.2	42.0	66.7
Heavy	42.6	46.3	50.7	26.0
Eye color	MALE		FEMALE	
Black	2.9	3.4	13.0	15.5
Dark brown	97.1	94.1	82.6	81.4
Light brown	0	2.5	4.3	2.1
Blue	0	0	0	1.0
Conjunctiva				
Clear	23.5	18.8	45.4	42.7
Not clear	76.5	81.2	54.6	57.3
Epicanthic eye fold				
Absent	68.1	56.8	47.8	53.6
Trace	27.5	29.7	43.4	26.8
Medium	2.8	8.1	8.8	14.4
Marked	1.4	5.4	0	5.2
Nasal bridge				
Low	21.4	21.7	56.9	30.5
Medium	64.3	70.4	39.1	67.4
High	14.3	7.8	4.3	2.1

CHARACTER	MALE		FEMALE	
	Samoan	Tongan	Samoan	Tongan
Axes of nostrils				
Anterior posterior	2.9	1.7	0	5.3
Oblique	57.3	78.3	39.1	69.5
Transverse	39.7	20.0	60.9	25.3
Slope of forehead				
Vertical	40.0	60.3	85.7	84.4
Moderate	58.5	38.8	14.3	15.6
Low	1.5	.9	0	0
Glabella				
Smooth	29.4	49.1	100.0	83.5
Medium	55.8	42.8	0	15.5
Prominent	14.7	8.0	0	1.0
Lips				
Thin	0	10.3	4.3	10.3
Medium	92.8	83.6	91.4	87.6
Thick	7.1	6.0	4.3	2.1
Prognathism				
None	56.7	53.3	69.6	46.4
Slight	23.8	22.0	13.0	37.1
Medium	17.8	24.6	17.4	15.5
Marked	1.4	0	0	1.0
Keilodonty				
Lateral incisor teeth:				
No rim	51.5	42.1	57.1	36.3
Trace of rim	34.3	42.9	23.8	40.6
Medium rim }	14.1	14.9	19.0	23.1
Marked rim }				
Mesial incisor teeth:				
No rim	68.2	57.9	76.0	62.6
Trace of rim	25.7	29.8	14.3	26.4
Medium rim }	6.0	12.3	9.5	10.9
Marked rim }				

Although the differences are small it may be profitable to further analyze those that do occur. Head length and breadth and, consequently, the cephalic index are almost identical in the two groups, but the Tongans have slightly lower, narrower faces, lower noses, a higher average nasal index and lower average cephalo-facial indices. There is also noticeable a slightly greater tendency to have wavy or curly hair. Beards are slightly heavier and body hair more plentiful. There is more conjunctival pigment in the Tongans and a higher frequency of the epicanthic eye fold. There are fewer highly arched nasal bridges.

EVIDENCES OF MELANESIAN INTERMIXTURE

Although the differences between Tongans and Samoans are very slight, yet almost without exception they point in the direction of Melanesia. Of the Samoans⁶ I said that considering the group as a unit there seems to be very little Melanesian blood in evidence. On the basis of cultural or linguistic affinities it is common to assume a large amount of Melanesian blood in all Polynesian groups. If such blood exists it should be easily demonstrable. Melanesian intermixture should result in a lower stature, longer heads, broader, shorter noses, shorter ears, more curly, frizzly, or woolly hair, more beard and body hair, a smaller transverse fronto-parietal index, a lower, narrower face, greater prognathism, and a heavier development of the glabella and supra-orbital region. A large percentage of the difference between Tongans and Samoans is of a nature that from purely theoretical reasons I suggested might be expected to result from Melanesian mixture. As a matter of fact there are few or no careful and detailed descriptions of those Melanesian groups that are geographically nearest to the Tongans and very meager data from the area as a whole. In order to state with any finality what might be expected from the mixture of Polynesians and Melanesians, in lieu of any absolute data on the question, detailed and accurate descriptions of several living Melanesian groups would at least be necessary.

Assuming, however, that I have stated with approximate accuracy what might be expected in such a mixture, the analysis can be carried a step further. As a test woolly, frizzly, curly, deeply waved, and, to a less extent, low-waved hair, may be taken to indicate Melanesian physical mixture. If it does indicate Melanesian mixture and this mixture has taken place on a large scale within fairly recent times, it is to be expected that persons with wavy and curly hair will show other Melanesian characteristics. By this I do not mean that there is necessarily any high correlation between the combinations in which physical characters are inherited when two races mix but that, purely on the basis of chance, if curly, wavy hair indicates the presence of Melanesian blood, it is reasonable to expect that the curly, wavy-haired group, as a unit, will show a closer approach to the Melanesian average than will the straight-haired group.

Accordingly I have divided my material on the basis of hair form into three groups. The first group includes the straight-haired persons, the second group those with low waved hair, and the third group includes all with deeply-waved, curly, or frizzly hair. I have compared these three groups with the total series. The averages of the three groups do not necessarily equal the averages of the total series since the data for a number of persons who were doubtfully marked "straight to low waves" or "low waves to deep waves" were excluded in making up the

⁶ Op. cit., p. 96.

smaller groups. In seriating these doubtful types of hair form in the summary, I alternately placed one of these in the lower class and one in the upper class. In obtaining averages of groups based on hair form, it seemed best to exclude the data marked "doubtful." The averages for the anthropometric characters in these four groups will be found in Table VIII.

TABLE VIII.—AVERAGES OF ANTHROPOMETRIC CHARACTERS FOR TONGANS WITH DIFFERENT TYPES OF HAIR FORM

MEN				
Character	Total group	Straight hair	Low-waved hair	Deep-waved to woolly hair
1. Stature	173.0	171.0	173.9	173.2
2. Head length	191.0	189.3	193.2	192.2
3. Head width	154.8	154.3	155.2	156.9
4. Minimum frontal	104.8	102.4	106.1	103.3
5. Face width	143.5	144.7	145.2	143.9
7. Face height	128.2	129.7	129.0	128.3
8. Nose height	57.5	58.9	57.8	57.0
9. Nose width	44.4	44.3	44.8	45.6
12. Cephalic index	81.1	81.3	80.3	81.8
13. Fronto-parietal index	67.6	66.3	68.3	66.0
14. Cephalo-facial index	92.8	93.7	93.7	91.9
17. Facial index	89.2	89.8	88.9	89.3
18. Nasal index	77.6	75.5	77.7	80.4

WOMEN				
Character	Total group	Straight hair	Low-waved hair	Deep-waved to woolly hair
1. Stature	162.5	161.3	163.1	162.3
5. Face width	136.1	137.0	137.2	136.4
7. Face height	124.1	124.0	124.5	123.3
8. Nose height	56.7	57.3	56.8	56.1
9. Nose width	41.9	42.1	41.9	41.8
12. Cephalic index	81.6	81.0	82.2	81.2
13. Fronto-parietal index	68.7	69.1	67.9	69.3
14. Cephalo-facial index	91.2	91.5	91.0	90.9
18. Nasal index	74.2	73.6	74.2	74.7

There are no consistent differences between the straight-haired and the low-waved groups. But in the groups containing the persons with deeply waved, curly, frizzly, and woolly hair we notice that the averages again point in the direction of Melanesia. The faces are lower and narrower, the noses are lower and wider, the average cephalo-facial index is lower and the nasal index is higher.

Emphasizing, then, more the nature than the magnitude of the difference, I am inclined to believe that in those traits in which the Tongans differ from the Samoans the differences may probably be attributed to Melanesian intermixture.

DISCUSSION AND CONCLUSIONS

Comparison of the Tongans with the Samoans has thus shown remarkably close resemblance between these two groups in almost every detail. The few small differences might well be considered as accidental or as reflecting slight local differences, were it not for the fact that they point in the main in one direction. From the general direction of these differences it seems most reasonable to assume that they are the result of Melanesian intermixture.

In another publication⁷ I stated that I saw no reason for assuming any appreciable amount of Melanesian blood in Samoa. Perhaps this statement should be qualified to make its meaning clearer. The census returns show that there are in Samoa and Tonga a considerable number of natives of Fiji and other Melanesian islands. In both of these island groups there are persons of known and admittedly mixed Melanesian-Polynesian parentage. These facts are known and require no anthropological research to establish them. In view of these facts it is desirable to determine to what extent the population styling itself as of pure Samoan or of pure Tongan origin has been in the past affected by Melanesian intermixture.

This problem can be solved only by determining the degrees of differences and likenesses in the groups concerned. The results, however, can be expressed only in general terms, for there are no known factors in the equation. From the marked general differences in physical type between Samoans and Melanesians I conclude that the amount of Melanesian blood in Samoa is very small. This may be due to the fact that intermixture never took place on a very large scale in Samoa, or that if it did take place on a large scale it was so long ago that the Melanesian element is almost completely absorbed by the general Samoan population.

In Tonga conditions are somewhat different. Enough Melanesian blood is in evidence to alter noticeably the average physical type. But such correlation exists between the various Melanesian traits in individuals and groups that when individuals are classed on the basis of one Melanesian trait the averages in many other traits also reflect the Melanesian intermixture more clearly than do the Tongans as a whole.

From this it may be assumed that the Melanesian element in Tonga is either comparatively recent or considerable in amount. The chances are in favor of recent rather than great intermixture, but since skeletal material of known chronological sequence is lacking, no definite conclusion is possible. It may be said, however, that without much doubt there is considerably more Melanesian blood in the general Tongan population than there is in the general Samoan population.

In their broader racial affinities the Samoans and Tongans are very similar, and therefore what I have said of the Samoans holds for the Tongans. Never-

⁷ Op. cit.

theless it seems desirable to repeat the discussion in my paper on Samoan Somatology⁸ and to extend it somewhat.

I have stated my belief that there was little or no reason for assuming the Samoans to be of European or Caucasian origin. From the evidence available I have concluded that the Samoans are of Mongoloid or Yellow-Brown affinities. Scientific opinion has wavered back and forth on the question as to whether there was or was not justification for calling the yellow and the brown elements of this stock separate races. Everyone must admit that there is some justification for so doing. Superficially there are some striking differences in the two stocks. When all the groups composing this stock are considered, anthropologists have found that the two elements have a considerable number of very important characteristics in common. One group may depart radically from the other groups in one or two characters but in all other characters will approach the form prevailing in the majority of the groups. At present the line of cleavage between the yellow and brown elements of this stock seems to be rather well marked. This is probably due not to the fact that such a gap exists but that our data is lacking on many interesting and connecting types. The Chinese, the Japanese, the Koreans, the numerous Siberian peoples, and many other similar Asiatic groups constitute the yellow element of this group. The American Indians, the Malays, the Indonesians and in my opinion the Polynesians constitute the brown element of the Yellow-Brown race. Each one of these groups named represents a departure from the other groups in a greater or less number of important characteristics. Yet analysis reveals a large number of remaining characteristics pointing clearly to its major affinities.

It is for this reason that I insist that no classification based on hair form, cephalic index, or any one single character should be taken too seriously. It may very well be that the one character which was hit upon as a basis for classification may be the very one in which the group under discussion has become differentiated from its closest relatives. Relationship must be based on a totality of characters—the larger the number of physical characters used in indicating relationships the greater the probability that the relationship indicated is a real one.

The evidence for a Caucasian origin of the Samoans and Tongans is decidedly sparse and unconvincing. They do depart somewhat from the bulk of the Yellow-Brown peoples in hair form. Coarse, stiff, or lank black hair occurs only rarely in these two groups. The prevailing form is moderately coarse in texture and either straight or, quite as often, slightly wavy in form. This more than any other one thing is responsible for the theory of a European origin of these peoples. Now while the hair is not so stiff, straight, and coarse as the prevailing form of hair in the Yellow-Brown peoples, neither is it so fine as the

⁸ Op. cit.

prevailing hair form of the Caucasians. I do not wish, however, to make too much of this point and am willing to grant that in this one character the Samoans and Tongans approach nearer to the Caucasian than to the Yellow-Brown types. The same can be said of the lack of prognathism and of the development of the chin. But it should be remembered that the Polynesians are not alone among the Yellow-Browns in thus approaching a Caucasian norm. Certain American Indians approach the Caucasian norms even more closely in the lack of prognathism, elevation of the nose, and in the development of the chin.

A few other characters upon which we have data are intermediate between the prevailing Caucasian and Yellow-Brown norms. In detail these are hair texture, amount of beard, amount of body hair, size, shape and direction of the palpebral fissure (eye opening), low frequency of the epicanthic eye fold, low frequency of the enamel rim on the upper incisor teeth, the size of the teeth, the hair color (occasionally a slight brownish tint in sunlight) and the cephalo-facial index.

But in skin color, eye color, the amount of conjunctival pigment, the elevation of the nasal bridge, the form and direction of the nostrils, nasal height, nasal breadth, nasal index, the thickness of the lips, the large massive faces reflected in the face height, face width, and bigonial width, the Samoans and the Tongans differ from the Caucasians and approach more nearly the norms of the brown division of the Yellow-Brown race. These characters may be summarized in tabular form as follows:

TABLE IX.—RACIAL AFFINITIES OF THE TONGANS AND SAMOANS

A. Approach Caucasian norms in:	B. Intermediate between Caucasian and Yellow-Brown in:	C. Approach Yellow-Brown norm in:
Hair form Lack of prognathism Chin development	Hair texture Amount of beard Amount of body hair Form of palpebral fissure Absence of eye fold Absence of incisor rim Hair color Cephalo-facial index	Skin color Eye color Conjunctival pigment Nasal bridge Nostrils Nasal height Nasal breadth Nasal index Lips Face width Face height Bigonial diameter

It will be noted that many characters occurring in both races but distinctive of neither have been omitted. I may likewise have laid myself open to criticism by assigning any one character exclusively to one race. This has been done consciously for the sake of clearness in presentation. In saying, for example, that

the Tongans and Samoans approach the norm of the Yellow-Brown race in skin color, I say it knowing that a few Caucasian groups have a skin color nearer to that of the Tongans and Samoans than to many Yellow-Brown groups. Yet on the whole brown skin is more distinctive of the Yellow-Brown peoples than it is of the Caucasians. I have also perhaps been somewhat too generous in admitting that certain characters approach the Caucasian norm when they also approach the norms of other race groups. While I have said that in the amount of beard and body hair the Samoans and Tongans approach the Caucasian norms it should be remembered that in these respects they approach just as closely the Melanesian norm.

Beyond saying that the bulk of the data at hand seems to point to the conclusion that the Polynesians under discussion belong to the brown division of the Yellow-Brown race in the same sense that it is customary to regard the American Indians as members of this race, it seems unwise to go further at this time. From this it should not be assumed that the relationship of the Polynesians and the American Indians is immediate and close. At present I would not care to do more than to express a belief that the relationship existing between the Polynesians and the American Indians is considerably closer than that existing between either the Polynesians or the American Indians and the Chinese. It is probable, however, that closer relatives to the Polynesian will be found nearer at hand.



A. TONGAN TYPES SHOWING THE RANGE OF VARIATION IN EYE FORM, THE CHARACTERISTIC HALF-OPEN EYES SOMEWHAT OBLIQUELY PLACED, AND THE SLIGHTLY THICKENED AND BEVELLED LOWER LID WITH JUST A SUGGESTION OF AN EPICANTHIC FOLD.



B. TONGAN TYPES SHOWING THE FORM OF THE LIPS, NOS. 1 TO 4 IN MEN AND NOS. 5 TO 8 IN WOMEN. NOS. 2, 3, 6, AND 7 ARE THE MOST COMMON TYPES. AS A GROUP THE TONGANS HAVE LIPS OF SOMEWHAT MORE THAN MEDIUM THICKNESS, DIFFERING QUITE MARKEDLY FROM THOSE OF CAUCASIAN PEOPLE.

Photographs by Gifford and McKern



A. PROFILES OF TONGAN MEN ARRANGED IN ORDER OF CHIN DEVELOPMENT. THE TONGAN CHIN THOUGH POSITIVE IS BY NO MEANS SO PRONOUNCED AS THAT OF CAUCASIAN PEOPLES. NOS. 3, 4, 5, AND 6 PORTRAY THE MOST COMMON TYPES.



B. PROFILES OF TONGAN WOMEN ARRANGED IN ORDER OF CHIN DEVELOPMENT. THE CHIN OF TONGAN WOMEN IS NOTICEABLY LESS DEVELOPED THAN THAT OF THE MEN. NOS. 3, 4, 5, AND 6 PORTRAY THE MOST COMMON TYPES.

Photographs by Gifford and McKern



A. PROFILES OF TONGAN MEN SHOWING THE ELEVATION OF THE NASAL BRIDGE AND THE PROFILE OF THE NOSE. NOS. 7 AND 8 SHOW A HIGHLY ELEVATED NASAL BRIDGE. THE NASAL BRIDGE OF THE TONGANS AS A GROUP IS NOT ELEVATED SO MUCH AS THAT OF CAUCASIANS.



B. PROFILES OF TONGAN WOMEN SHOWING THE RANGE IN ELEVATION OF THE NASAL BRIDGE AND THE CONTOUR OF THE NASAL PROFILE. THE NASAL BRIDGE IS SEEN TO BE MODERATELY ELEVATED. NO. 8 IS AN ABERRANT AND UNCOMMON TYPE.

Photographs by Gifford and McKern



TONGAN TYPES SHOWING THE RANGE IN NOSE FORM, NOS. 1 TO 4 IN MEN AND NOS. 5 TO 8 IN WOMEN. NOS. 2, 3, 6, AND 7 ARE THE MOST COMMON FORMS. NONE OF THE NOSES HERE PORTRAYED APPROACHES IN SIZE THE CAUCASIAN TYPES.

Photographs by Gifford and McKern

THE MATERIAL CULTURE OF THE
MARQUESAS ISLANDS

By RALPH LINTON

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THE MATERIAL CULTURE OF THE MARQUESAS ISLANDS

BY

RALPH LINTON

INTRODUCTION

GEOGRAPHIC SKETCH

The Marquesas include thirteen islands. The eight habitable islands form geographically two divisions—the Northern Division, which includes Ei Ao, Nuku Hiva, Ua Huka, and Ua Pou; and the Southern Division, which includes Hiva Oa, Tahu Ata, Moho Tani, and Fatu Hiva. (See fig. 1.) Ei Ao and Moho Tani, although formerly inhabited, are now deserted.

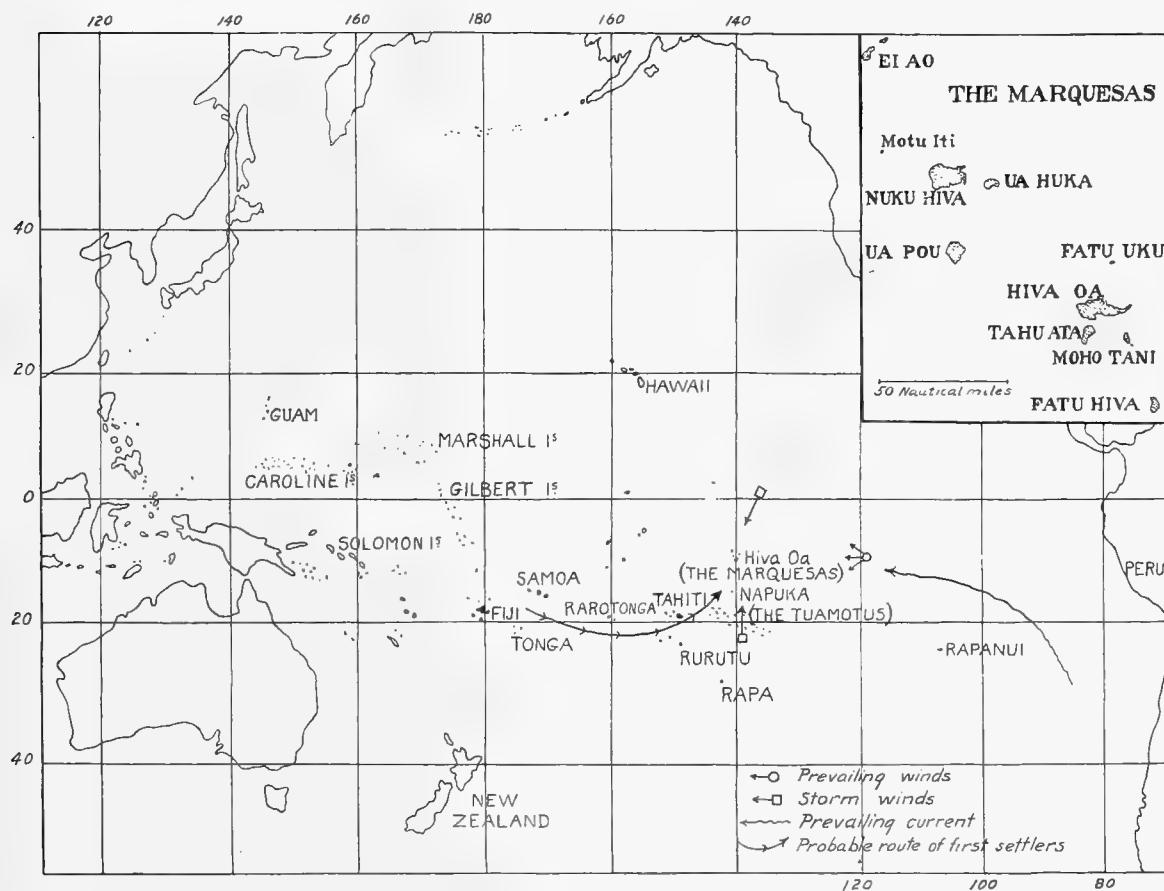


FIGURE 1.—Map of a part of the Pacific showing the position of the Marquesas and the principal islands of the group. The islands Ei Ao, Motu Iti, Nuku Hiva, Ua Huka and Ua Pou, constitute the Northern Division of the Marquesas, and the islands Fatu Uku, Hiva Oa, Tahu Ata, Moho Tani, and Fatu Hiva, the Southern Division.

The habitable islands are of volcanic origin. At present there are no signs of volcanic activity and earthquakes are unknown, but on some islands old sea caves now several meters above high water level suggest that elevation still continues. The topography of all the large islands is similar, each having a high central mountain chain from which sharp ridges, often ending in sheer cliffs, extend to the sea. With a few exceptions, the valleys are short and narrow. There is no coastal shelf and many of the valleys are accessible only from the sea. Nuku Hiva and Hiva Oa, the largest islands of the group, have so-called plateaus at altitudes of from one to two thousand feet. These plateaus include some areas of comparatively level ground, but are for the most part eroded into innumerable small, steep side valleys, which render traverse difficult, even for a man on foot.

The climate of the Marquesas is without extremes of heat or cold, the mean annual temperature being between 75 and 80 degrees Fahrenheit. Hurricanes, the scourge of the Tuamotus, are rare, but lying north of the belt of seasonal rains, the islands are visited by destructive droughts which have been known to last three years. Even in favorable years the climate throughout most of the group is dry rather than humid. There is a progressive decrease in rainfall from south to north; Fatu Hiva, the southernmost island, is well watered but Ei Ao, the northernmost, is arid. The prevailing winds are easterly and the westerly sides of the most of the islands are semi-arid, with few running streams.

The marked differences in the vegetation on different islands and on different parts of the same island correspond to variations in rainfall. On Fatu Hiva a dense growth of vegetation mantles the almost vertical sides of the mountains and fills the valleys with thickets. East of the high mountain ridge on Hiva Oa the valleys are choked with thick bush and the higher slopes are covered with forests containing many tree ferns. West of the ridge the tree ferns disappear completely, giving place to stunted guava scrub and upland reed, and large areas are covered with matted fern scarcely a foot high. Wherever a depression serves to collect the moisture there are open groves of pandanus or fau (tree hibiscus) while the higher ridges are crowned with straggling clumps of casuarina. The slopes of the deeper valleys are covered with a growth of large trees beneath which is little or no undergrowth and only along the water courses, where the fau grows in tangled masses, is there any approach to jungle. Were it not for the occasional clumps of palms in the valleys the visitor might imagine himself in the hills behind San Francisco rather than on an island within ten degrees of the equator. Ei Ao, the northernmost island, has the least rain, and its bowl-like top is covered with short grass and scattered groves of trees so open that a man on horseback could pass anywhere with ease.

From the point of view of the primitive settler, the Marquesas could hardly be considered desirable country. The mountains everywhere extend to the sea, and the little level ground on the plateaus is rendered uninhabitable by the droughts. The numerous valleys are for the most part small and many of them contain no land suitable for cultivation. Terracing, which might have increased the arable area, is almost useless without some system of irrigation, and this is rendered impossible by the uncertain rainfall. There are no native wild animals larger than the rat, and the absence of a barrier reef decreases the supply of fish, and makes fishing arduous and uncertain. Opposed to these disadvantages are a climate ideally suited to the growth of breadfruit and coconut, and at least partial immunity from attack as a result of the geographical isolation of the valleys.

SETTLEMENT AND POPULATION

So far as known there are no native accounts of the original settlement of the Marquesas. The legends collected by the Bayard Dominick Expedition show a belief in a local creation. Legendary material and the constant repetition of tribal and place names in the various islands of the group would seem to indicate that the historic inhabitants were descended from a few small parties of settlers who occupied the most fertile valleys of the southern islands first, spreading as their numbers increased until the occupation of the group was complete. There is no legendary evidence of organized conquest or of an early non-Polynesian population. The local differences in culture and physical type which existed in the Marquesas at the beginning of the historic period seem to point, however, to the presence of two originally distinct racial elements. One element, which was dominant in Hiva Oa, Tahu Ata and Fatu Hiva, showed many affinities with the Maori of New Zealand. The other element, which was dominant in Nuku Hiva, Ua Huka and Ua Pou, showed affinities with western Polynesia. It seems improbable that these two elements arrived in the group simultaneously but it is impossible to say which came first. In historic times the western Polynesian element in the Marquesas was strongest in the localities which were least desirable and farthest from the probable place of arrival of immigrants to the group. This may indicate that this element arrived first and had been ousted from the more favorable localities by the Maori-like element.

There seems to have been no important invasion of the Marquesas after their settlement by these two racial elements. The Tuamotus was the only island group near enough to serve as a base for organized attack and these islands were small and sparsely populated. It was not impossible for small bands of invaders to reach the Marquesas from time to time; but even if they were successful in this, the nature of the country would have limited their occupation

to a few valleys where, in the absence of reinforcements, they would eventually have been wiped out or would have merged with the native population.

A glance at a map of the Pacific (fig. 1) will show that in spite of their comparative immunity from attack the Marquesas are by no means isolated. The Tuamotu chain links them with the Society Islands on the south, and widely scattered islands to the northwest connect them more remotely with Hawaii. Small groups of castaways who had been driven out of their course must have arrived in the Marquesas from time to time and probably met with a friendly reception. There are numerous records of such involuntary voyages in other parts of Polynesia which show that great distances were sometimes covered in these drifts and influences from western Polynesia and even from Micronesia may have reached the Marquesas in this way. The Marquesans themselves made long voyages, some of which are said to have extended as far as Rarotonga with stops at others islands en route. They were not conservative and their natural mechanical ability made them quick to recognize the value of new appliances. It is probable, therefore, that the historic culture of the Marquesas was a blend of the culture of the two groups of early settlers plus a few features which had been introduced from widely diverse sources.

It seems certain that the population of the Marquesas had reached its saturation point before the time of the first European contact. Even the smallest and least hospitable valleys contain stone house-platforms, while the remains in the more favored localities indicate a dense population. Although the increase was checked somewhat by constant inter-tribal wars, the pressure had become sufficiently acute to lead to a resumption of organized expeditions in search of new lands. According to Porter (49, p. 93) the emigrants took with them domestic animals and plants in preparation for the founding of a new colony, and sailed under the direction of priests. The magnitude of the exodus may be judged from the fact that Porter's informant, Wilson, told him that, to his knowledge, eight hundred men, women and children had left the group in this way, none of whom had ever been heard of afterward. At least one of these emigrant groups is known to have established itself in an island of the northern Tuamotus, but the greater part probably sailed on westward into the empty ocean until they perished.

The various early estimates of the population of the Marquesas have been collected by Clavel (12) as follows: Cook, in 1773, estimated 50,000 for the Southern Division alone, giving 100,000 for the whole group. Krusenstern, in 1804, gave 16,000 for Nuku Hiva alone on the word of a resident European, but considers 12,000 as more probable. This would mean about 50,000 for the whole group—an estimate Clavel considers the best. Porter, in 1813, gave the popu-

lation of Nuku Hiva as 80,000 which is obviously an impossible number. During the early part of the nineteenth century the population declined rapidly as a result of diseases introduced by the European whalers. Du Petit-Thouars, in 1838, estimated the population at 20,000; Houan, in 1856, gave 12,500 as the grand total, and an actual census at the time of Clavel's visit in 1883 showed 4,865. Since that time the decline has been steady but less rapid, the present inhabitants numbering about 3,000, many of whom are Chinese or European half-castes. These half-castes are more resistant to disease than the pure-blood natives and through them the language and fragments of the culture will probably be preserved for several generations. The survival of the pure native stock is doubtful, although in 1920 the natives of the island of Ua Pou, who were only slightly mixed, were holding their own, and those of Ua Huka showed a slight increase in number. The most rapid decline is in the southern islands where intensive European contact is more recent. On one of these islands, Tahu Ata, there are said to be nearly a hundred deaths to every birth. The influenza epidemics, so destructive in Polynesia, did not reach the Marquesas.

SOCIAL ORGANIZATION AND RELIGION

An account of the religion and social organization of the Marquesas is given by Handy (32), but a resume is necessary as a background for the present study of material culture.

The natives were divided into a great number of tribes which were for the most part mutually hostile. As a rule each of these tribes occupied a single valley, but several of the larger valleys were occupied by two or more tribes who often fought among themselves, although they usually united against outsiders. Thus in the valley of Tai-pi Vai, rendered famous by Melville's narrative, "Typee," there were three groups of people. One group occupied the head of the valley; a second, the middle; and a third, the lower end. The hostility between these groups was so strong that even after their ostensible conversion to Christianity it was necessary to build a church in each section to prevent fights during religious services. No governmental unit larger than the tribe existed, but there appear to have been shadowy confederacies of several tribes, who combined for action in case of hostilities from other tribes. In Nuku Hiva and Hiva Oa at least, there were still larger dual divisions, comprising the eastern and western halves of these islands. The only approach to centralized power appears to have been in the island of Ua Pou, where the inhabitants of one valley had extended their sway over all the other tribes, but even here the autonomy of the conquered groups does not seem to have been seriously interfered with.

At the head of the tribe stood the chief, but he appears to have been a different functionary from the Hawaiian or Tahitian ruler. The concepts of divine descent and absolute power were lacking among the Marquesans, and there was no sharp line of demarkation between the ruled and ruling classes. As in all other parts of Polynesia, the office was hereditary, but the chiefs frequently sought to strengthen their position by alliance with influential families of commoners. Such alliances were formed principally through adoption, and the chieftainship might in this way pass out of the line of actual blood descent. The chief was looked upon as the director of group activities, and in some places at least, as the owner of the tribal lands. His power was by no means absolute, however, and in case of oppression his followers might desert and pass into the service of another chief. It is an interesting fact that the chief does not seem to have been expected to expose his person in war. Battles were directed by war leaders (*toa*) who were men of proved valor. Within many of the fortifications visited, small enclosures were pointed out as the place where the chief took refuge with a body-guard of picked men, during an attack.

Second to the chief, and with power almost equal to his, was the inspirational priest (*tau'a*). This personage was believed to be the mouthpiece of the god, and as such had much influence in secular as well as religious matters. The relative power of the chief and *tau'a* in any community no doubt depended largely upon their personalities, but on the whole the power of the *tau'a* appears to have been inferior, final decision in most matters resting with the chief.

Next in importance below the chief and *tau'a* ranked the heads of large families. Below these in turn seem to have been classed the master craftsmen of various trades, *tuhuna*. Such men appear to have been regularly instructed and were extremely jealous of their trade secrets. They were employed and well paid by chiefs and rich commoners, who fed and housed them while the work was going on. It is an interesting commentary on the position of the skilled workman in the social scale that even chiefs did not consider it below their dignity to make and sell objects. Gracia (28, p. 149) mentions a chief who derived most of his revenue from carving pipes.

In spite of the difficulties of land communication, the lack of centralized authority, and the almost constant inter-tribal wars, the isolation of the various valleys was more apparent than real. Due to the involved native relationships, and especially to the practice of adoption, many individuals were under the protection of more than one tribe and could serve as go-betweens. *Tuhuna* of important trades also appear to have been able to travel with considerable safety as their services were much in demand. Great fetes given by one tribe were often attended by contingents from other tribes with whom the givers were tempo-

rarily at peace, and some stories indicate that visits paid by one tribe to another were not unknown. Such fetes and visits frequently ended in a general fight, but they gave an opportunity for the exchange of ideas and objects, and tended to break down any cultural differences which may have existed. Still more important factors in the establishment of cultural unity were the local industrial specialization, and the trade which certainly existed in pre-European times. At present it is difficult to determine the extent of specialization and trade. All the larger valleys, at least, were able to manufacture the objects that they used, but because of better materials, or of superior technical skill, particular valleys or islands were recognized as preëminent in the making of objects of a certain class. Thus some stone adzes were unquestionably manufactured almost everywhere in the group, but those made on the island of Ei Ao were of better material and were regularly exported. The great size of the Ei Ao workshops would seem to indicate quantity production, and it is evident that the workmen specialized in the finer and less bulky forms. Similarly the islands of Ua Huka and Ua Pou contained large deposits of rock suited to the manufacture of *popoi* pounders and exported many of these implements to other islands. The natives of Nuku Hiva knew how to manufacture a special kind of yellow paint or dye which was highly valued in the other islands, while those of Fatu Hiva were famed for their skill as carvers. There seems to have been no formal trade; there was no regular medium of exchange and even the existence of definite barter is doubtful. The transfer was in the nature of a gift exchange.

The material culture of the Marquesas as a whole was almost uniform, a fact the more remarkable in view of the dialectal differences between the Northern Division and the Southern Division of the group, and even between different tribes on the same island. The local differences which exist have been pointed out in the body of this report. The long contact between Europe and the Marquesas has resulted in the almost complete destruction of the native culture and the information obtainable regarding ancient customs and materials is often fragmentary. The use of certain objects in museum collections has been entirely forgotten and only the names of many other artifacts are remembered.

SCOPE AND ACKNOWLEDGMENTS

The scope of the present paper has been purposely restricted to an account of the material culture of the Marquesas. Certain obvious similarities and differences between the Marquesan culture and that found in other Polynesian islands have been pointed out, but a thorough comparative study has not been attempted. Detailed descriptions of the preparation of food and of the ritualistic observances accompanying the various industries have been omitted. They are discussed by my colleague, E. S. Craighill Handy (32).

Thanks for kindness and hearty cooperation are due to many European residents in the Marquesas, especially to M. Du Poyen de Belleisle, Administrator of the group, M. Paul Vernier and Mr. Frank Varney of Atuona, Pere Simeon Delmar, of Taiohae, and Mr. Henry Lie of Pua Ma'u.

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The use made of photographs received from various sources is acknowledged in the legends accompanying the plates. Except as otherwise indicated, the illustrations are based on material in the Bernice Pauahi Bishop Museum.

HOUSES

THE MARQUESAN DWELLING AND ITS ADJUNCTS

The establishment of a Marquesan commoner consisted of only two houses, the dwelling and a cook house—an open shed with a frame of the dwelling type. Both buildings stood in a small yard which was often enclosed by a rough stone wall about three feet high. Rich commoners had another house, the store house (*fata'a*), which was usually built near the end of the dwelling. A chief's establishment was much more elaborate, consisting of a dwelling, a cook house, a store house and a men's house or warriors' house which served as an eating place for the chief and as a general club room and assembly place for his male friends. Both the store house and warriors' house were tapu to women. The chief's establishment was always built near the tribal assembly place (*tohua*) and the public sacred place (*me'ae*). Both of these structures were considered the property of the chief.

Very few buildings of aboriginal type are in use in the Marquesas at the present time and no large structures of ancient form have been erected in recent years. The Marquesans appear to have had only two types of houses although there were several minor variations of one of these types. One type, which will be referred to as the small house type, was used for all sorts of small and temporary structures built with a minimum of labor. The other, which will be referred to as the dwelling type, was used for residences and for all other large and permanent buildings. Most houses were built on the ground or on stone platforms (*paepae*) but a few structures, notably the store house and the houses in which young people received religious instruction, were raised on posts.

THE SMALL HOUSE TYPE

Small temporary houses were erected for the accommodation of women during childbirth, as dwellings for solitary old people, as places for the tattooing of women and commoners and as camping places in uninhabited valleys. As a rule such houses were built on the ground without a stone platform and were of simpler construction than the dwellings. The framework consisted of two end posts supporting a ridge pole against which two rows of light poles were leaned from either side, forming the rafters. The main timbers were not dressed but the rafters, commonly of *fau* wood, were stripped of their bark. This bark was twisted into strings and later used to tie on the thatch. The timbers of the framework were lashed together with bark string. The thatch was usually made of coconut mats arranged longitudinally, the lower edge of each mat overlapping the top of the one below. These mats were fastened to the rafters by strips of

fau bark passed around the heavy split midrib which formed the upper edge of the mat. The completed house was triangular in cross section, being in fact a simple roof with the eaves resting on the ground. One of the ends was usually closed with coconut mats, arranged like those on the roof, and tied to the end rafter on each side and to the end pole. Houses of this type were simply shelters made with the minimum of labor, and were never decorated. They are still in occasional use throughout the Marquesas, and appear to be the same in all the islands.

THE DWELLING TYPE

THE HOUSE PLATFORM (PAEPAE)

The dwelling type includes practically all Marquesan buildings, whether domiciliary or ceremonial, although certain religious structures reveal a modified form. Nearly all permanent houses in the Marquesas were built upon stone platforms, known as *paepae*. The use of stone platforms was so nearly universal in Polynesia that it seems probable that the idea was brought to the Marquesas by the original settlers, but the nature of the terrain was such as to greatly stimulate its development. In most of the valleys it was necessary to either terrace or excavate in order to have a level floor and the abundance of loose stone made terracing easy. Many of the *paepae* on hill slopes were simple terraces with a trench at the rear to carry off water. The front height of such *paepae* depended, of course, upon the slope and the width of the level space desired. Front walls as much as ten feet high were not uncommon but the back of the terrace was usually at the level of the original surface, or only sufficiently raised to keep the floor from being flooded in rainy weather.

Even on level ground nearly all the houses were elevated on stone substructures which were sometimes remarkably massive. The natives stated that these level ground *paepae* were intended to keep pigs from entering the house. The alternative of erecting the house on piles was prohibited by the danger that children might get under it—a serious matter under the old regime, as anything which passed over a child's head became tapu and had to be destroyed. *Paepae* on level ground ranged from simple pavements—a form usually limited to dry localities—to massive structures six to eight feet high. The average height for all the Marquesan *paepae* is about three feet. They are highest in Nuku Hiva from which island they steadily decrease southward, the Fatu Hivan *paepae* being, on the whole, the smallest in the group. All *paepae* were rectangular in outline, the upper surface being divided longitudinally into two unequal parts one of which was from eight to thirty inches higher than the other. The higher part, which was always at the rear, served as the floor of the house and the lower part as a veranda and general lounging place. In Nuku Hiva and Ua Huka the *paepae*

were much wider in proportion to their length than in Hiva Oa, Tahu Ata and Fatu Hiva, many of them being almost square, but the house floor was everywhere long and narrow. The local differences are due to the greater or less width of the veranda part.

The perfect *paepae* contains stones of three sorts: large irregular stones, preferably water-worn, used for the walls; flat, water-worn boulders, used to pave the veranda and house floor; and large rectangular slabs of cut stone (*ke'etu*), used to face the front of the elevated house floor. The *paepae* show all degrees of variation, from this ideal arrangement, depending upon the materials available, the importance of the owner and the local excellence of the mason's art. In Nuku Hiva the *ke'etu* facing of the house floor was a practically constant feature. In Ua Huka *ke'etu* facings were common but not constant and in Hiva Oa they were limited to a few of the better built houses, usually those of chiefs. In Fatu Hiva *ke'etu* were very rare. The use of flat water-worn boulders for paving was much more usual but even these were sometimes dispensed with. In one of the interior valleys of Hiva Oa practically all *paepae* were built of rough stones throughout. The *paepae* of a chief's house in the valley of Haka Ui, Nuku Hiva, had the house floor paved with large flat slabs which had apparently been split like European flag stones. As Stewart (59, p. 291) mentions the use of flags in this or a similar structure in Haka Ui in 1831, their presence can scarcely have been due to European influence.

After the introduction of metal tools cut stone in the form of rectangular blocks was frequently used for *paepae* and in a few recently built *paepae* the stones were set in ordinary lime mortar.

The building of the *paepae* was supervised by a special *tuhuna* who drew on the ground the outline of the structure and with his own hands laid the first complete course of stone. He merely supervised the remainder of the construction, leaving the actual labor to the friends and relatives of the owner. The same *tuhuna* also supervised the construction of *me'ae* and other ceremonial structures, but he appears to have been simply a master builder, not a priest.

After the first course of stone had been laid, the space thus enclosed was filled with earth and stones, and the process was repeated after the laying of each successive course until the desired height was reached. The stones of the side walls were usually arranged so as to give the largest possible external surface, although a phrase in Dordillon's Dictionary (17) "*E tuku te kea matapao kaoko*" (Solid masonry—to place the long way of the stone in the thickness of the wall) shows that a more stable form of construction was known. After the side walls had been constructed the *ke'etu* were set on edge along the front of the proposed house floor, a third or even a half of their width usually being imbedded in

the *pacpac*, and then the house floor was walled and filled until level with their tops. Whether the placing of the *ke'etu* took place before or after the paving of the front part of the *pacpac*, could not be ascertained. Finally the surface of both parts of the *pacpac*, with the exception of the bed space of the house, was paved with flat water-worn stones, those of the house floor being smaller and more carefully selected. Holes for the accommodation of the front posts of the house were frequently left along the front edge of the floor.

A curious feature not observed at the present time, is mentioned by Petit-Thouars (48, p. 345) in his description of a chief's house on the island of Tahu Ata. He says, "At either end of the single apartment which forms the house there is a part of the pavement raised about thirty-five centimeters above the rest. These two platforms appear to be more exclusively reserved for the king."

One or two stone back rests were a rather common feature of dwelling *pacpac* in Hiva Oa. These back rests were simple slabs, usually undressed, set into the pavement of the veranda section and sloping at an angle of about 45 degrees. They were commonly placed at either end of the *pacpac* and so arranged that the occupant sat with his side toward the house. One interesting back rest of this sort, of recent construction, was carved from the top of a large stone set in the last course of the *pacpac* wall (Pl. XL. a, b). These objects appear to have been simply a primitive form of easy chair, with no religious or ceremonial significance, but it should be noted that similar back rests were occasionally placed within the bed spaces of houses within the precincts of the *me'ae* of Hiva Oa. When they were arranged in this position they were placed against the back of the house, sloping inward, so that the occupant faced the front of the house. A few stone back rests were observed in Nuku Hiva and Ua Huku but they were uncommon there.

In the paved space before the house, many large Nuku Hivan *pacpac* have a rectangular pit running down to the original ground level. These pits are lined with stones throughout and were certainly built at the same time as the *pacpac*. Two explanations of these pits were given by informants: That they were repositories into which objects that had become tapu were thrown and that they were larders or small *ma* pits. It seems unlikely that they were used as *ma* pits, however, as *ma* can only be preserved properly in pits dug in compact clay soil. Several old informants claimed that they had seen objects which had become tapu through touching the head of the oldest son thrown into such platform pits. In the valley of Hatiheu, Nuku Hiva, a pit of this sort had been used as a burial place for the owner's family, which had been wiped out by an epidemic. The house was afterward burned and the place declared tapu. Similar pits are a constant feature of the simplest form of *me'ae* in Nuku Hiva, but the majority of the *pacpac*

in which they occur are unquestionably those of ordinary dwellings. No pits were observed in the dwelling *paepae* of Hiva Oa and the natives had no knowledge of such a feature. The single example seen on Fatu Hiva was in the valley of Omo'a in a *paepae* built for a chief's house; it was explained as a place for the temporary storage of food. The occurrence and use of these pits is of interest in connection with the skull pits found in many *me'ae* throughout the group.

All the Marquesan valleys afford an abundance of loose stone, a condition which, coupled with the constant necessity of building platforms and terraces, led to a development of the art of dry stone masonry truly remarkable in a people otherwise as primitive as the Marquesans. It would be difficult for Europeans to improve on the workmanship shown in many of the ordinary *paepae*. The builders seem to have taken pride in using the largest material available, boulders weighing half a ton being quite common in these purely utilitarian structures.

POSITION OF THE HOUSE

As a rule there was only one house on a *paepae*, but a few *paepae* were observed on which there appeared to have been two, and possibly even three houses arranged longitudinally on the raised rear portion. None of the sites of this sort looked to be very old, and it seems probable that this was a recent development. Such a house group consisted of one large structure, the dwelling, with a small detached building at one or either end. The earth of the unpaved floors of the small buildings contained much ash and charcoal, proving them to have been cook houses. Normally a single house covered the entire rear raised section of the *paepae*, the floor of which was divided longitudinally into two almost equal sections. The front section, which formed the house floor, was paved with flat water-worn boulders, usually small and of uniform size. The rear section, which formed the foundation for the bed, was unpaved, and its surface stood six to eight inches below the level of the floor.

FRAMEWORK OF THE HOUSE

The main timbers of the house were commonly made from breadfruit wood, but *mio* (*Thespesia populnea*) was also employed, especially when the posts were carved into tiki form. The timbers were carefully hewn and dressed and sometimes were elaborately carved. The essential elements of the framework were the end posts and the ridgepole, the front posts and the stringer. The great length of some of the ancient houses, upward of a hundred feet, necessitated the use of additional posts in regard to which Gracia says (28, p. 123), "If it is thought on account of the length [of the house] that the first two posts are not sufficient they plant a third just in the middle of the hut, or even a row." None of these very large structures have survived, and it is impossible to give additional details.

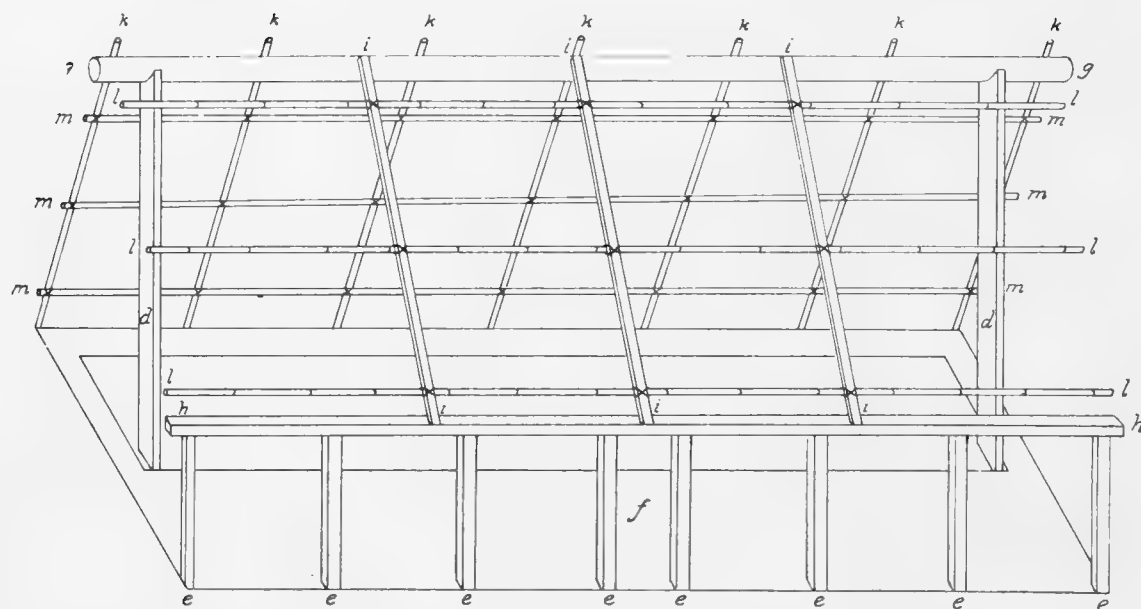


FIGURE 2.—Diagram showing framework of a house: *d*, end posts; *e*, wall posts; *f*, door; *g*, ridgepole; *h*, stringer; *i*, rafters of front roof; *k*, rafters of back roof; *l*, cross braces of front roof; *m*, cross braces of back roof.

In ordinary houses the ridge pole is supported by two posts placed one at either end. These posts are triangular in cross section and taper slightly toward the top, where they are deeply notched to receive the ridgepole. (See fig. 3.)

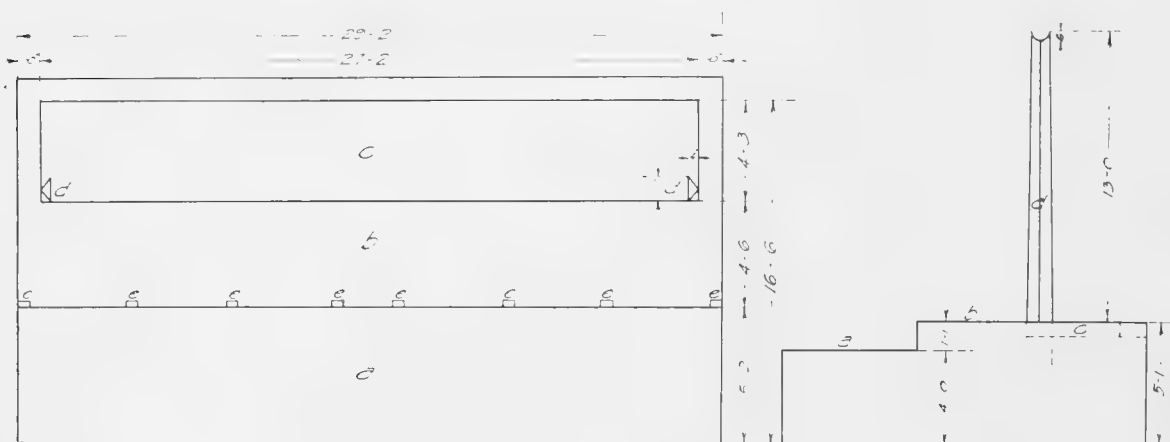


FIGURE 3.—Diagram of a house: *A*, ground plan; *B*, end view showing elevation of the paepae. The parts of the structure indicated are: *a*, paved space in front of the house; *b*, paved floor of house; *c*, bed; *d*, end posts; *e*, wall posts.

Measurements of an end post from a typical dwelling house are: height, (from surface of *paepae*) 13 feet; width at bottom, 12 $\frac{1}{4}$ inches; width at top, 8 inches;

thickness at center (bottom) $4\frac{1}{2}$ inches; thickness at edges, 2 inches; depth of notch for ridgepole, 6 inches. The thickness of the edges remains fairly uniform for the entire length, but the central thickness decreases slightly toward the top. The end posts are planted at either end of the bed space, 6 to 8 inches within the line of the end wall of the house, their broadest sides being toward the interior of the house. In the houses of Hiva Oa the forward edges of the end posts rest against the rear edge of the paved house floor, but in those of Nuku Hiva the posts are placed a foot or more further back, giving the rear roof a much more abrupt pitch.

In all the houses seen the ridgepole was hewn from a single log and ran the entire length of the house, projecting slightly beyond the end walls. Informants say that a palm log was formerly used for this member, but all those seen were of breadfruit wood. Much care was evidently expended in shaping the ridgepole properly. The ridgepoles seen in the Northern Division were round and had been rubbed down to a smooth surface, while those of Hiva Oa were polygonal in cross section with eight to twelve facets of approximately equal width, each of which ran the entire length of the timber. The ridgepole rested in the notches of the end posts, but was not attached to them in any way.

The front posts in ordinary dwellings varied in height from three to five feet, depending upon the size of the structure. In Hiva Oa and Tahu Ata they were commonly rectangular in cross section, but Stewart (59, pp. 233-236), who gives the best early description of Marquesas houses, says that those used in Nuku Hiva were round. The front posts of a large house on the island of Ua Pou were rectangular in the center, but tapered toward the top and bottom, and were almost round at the extremities. In Hiva Oa and Tahu Ata the central pair of posts, which formed the jambs of the door, were cut in such a way as to leave a projecting semicircular shelf at the top. When the posts were carved in the form of tiki a short cylindrical neck was usually left projecting above the head of the figure. The upper ends of the posts were either finished with a semicircular notch, like that on the large end posts, or with a neck which fitted into a hole pierced through the front stringer, or were simply left flat. It is probable that posts with notched ends or necks are ancient and that posts with flat ends were made after the introduction of metal tools.

There were usually six front posts, although houses with four and eight front posts were observed and large houses may have had more. The central pair were rather closely spaced, serving as the jambs of the door, while the others were placed at equal intervals between these and the ends of the house. In most of the structures visited the front posts were not planted in the platform; they were held in place at the bottoms by a deeply notched stringer running the entire

length of the house—probably a modern development. In the old house in Ua Pou they were planted immediately behind the *ke'etu* facing the raised house floor, and informants say that holes edged with flat stones were left for the front posts at the time the floor of the house was paved.

Three types of top stringer were used: A simple rectangular beam; a round log similar to the ridgepole, but of smaller size; and a peculiar L-shaped form, said to have been characteristic of the Southern Division in ancient times. Rectangular stringers were normal in recent structures and all those observed were either attached with nails to the flat tops of the front posts, or pierced with holes into which necks on the tops of the front posts fitted. The round stringers rested in semicircular notches in the tops of the front posts, and the only one seen in position was not attached to the posts in any way. The L-shaped stringers were hewn from single logs, and were placed outside the front posts, with their short arms against them and their tops level with the tops of the front posts. At each post the vertical part of the stringer was pierced with four holes, two above and two below, through which sennit lashings were passed back and forth around the front post. When the roof was in place these lashings were invisible from the outside. They were usually amplified on the inside to give an ornamental effect.

In a house at Atu Ona, Hiva Oa, there was an arrangement of posts and stringers similar to that of the front wall across either end of the house, and a single rectangular beam, resting upon the rearmost posts of the end walls, ran along the under surface of the rear roof and was attached to it at eight points. It is almost certain that this feature is due to European influence. A peculiar form of end frame, said to be a modern development, is described on page 295.

THE HOUSE ROOF

The front roof of ordinary dwellings was supported by three heavy rafters which were commonly hewn and squared. One rafter was placed in the middle of the house over the doorway, and the other two halfway between it and the ends of the house. (See fig. 2.) There were no heavy rafters at the ends of the roof, where they might be expected. The lower ends of these rafters rested upon the stringer, and their upper ends against the ridgepole, without extending beyond either. In well built houses the rafters were attached to both the stringer and the ridgepole by elaborate sennit lashings.

The framework thus formed was supplemented by additional rafters of bamboos, or peeled poles of *fau*, placed vertically at intervals of two or three inches, continuing above the ridgepole and crossing the small rafters of the rear roof. They also projected beyond the stringer and below the line of the front wall, forming narrow eaves. The light rafters were held in place by three longi-

tudinal poles, usually single bamboos, which ran the full length of the inside of the roof. The two outermost poles were placed eight inches to a foot above the stringer and below the ridgepole; the third pole was placed midway between them. They were attached to all the rafters by lashings of sennit or bark string. Both the front and rear roofs projected six inches to a foot beyond the end walls.

One house in Hiva Oa (Pl. XL. C) had a narrow porch supported by an additional row of posts, topped by a stringer. These posts were planted in the *paepae* about two feet in front of the house wall. The rafters of this porch were inclined at a lower angle than those of the roof. This feature was not observed elsewhere and was probably due to European influence.

The rear roof extended from the ridgepole to the ground. It was usually supported by eight main rafters, but these were not hewn so far as observed. They were simply peeled hibiscus poles of slightly larger diameter than those used for the remainder of the roof. In some houses all the rafters of the rear roof were identical in size and material. Between the main rafters were smaller poles placed two or three inches apart; at the peak they crossed the similar poles of the front roof forming a crotch. These smaller poles were secured in position on the rear roof by three cross poles of bamboo, the highest being opposite the top crosspiece of the front roof, the lowest about eighteen inches above the floor, and the third midway between them. All the rafters were lashed to these cross poles.

All the early descriptions of Marquesan houses mention the rear roof as perpendicular or descending at a very steep angle, and the old pictures show this feature, also a front roof inclined at less than forty-five degrees. Actual measurements prove that the old authors have exaggerated both these features. The pitch of the rear roofs ranges from eighty degrees in some of the houses of Nuku Hiva to as low as sixty-five degrees in an old dwelling on Hiva Oa. The pitch of the front roof seems to have been rarely, if ever, less than fifty degrees, with about sixty-five degrees as normal. In one old house in the valley of Hana Hehe, Hiva Oa, the pitch of the front and rear roofs is about sixty-five degrees for each.

The roofs of all Marquesan houses were thatched, and a variety of material was employed. In recent buildings coconut mats appear to be the most common, but two or even three sorts of thatch were not infrequently used on the same structure. The thatching mats, which were eight to twelve feet long and one foot to eighteen inches wide, were made by splitting a coconut frond down the midrib and interweaving the leaflets of either half to form a long narrow mat of checkerwork pattern. Mats of this sort are still in common use in most parts of Polynesia. The mats were placed on the roof either singly or in pairs, with the midrib edge up and were tied to every third or fourth rafter with loops or sennit or sewed on with bark string. A large wooden needle was used for sewing. The

thatch was lashed to each rafter with a single cord running the height of the roof. The bottom tier of mats was laid on first, and the successive tiers were laid on shingle fashion, with a deep overlap. As the successive layers were rarely more than two or three inches to the weather, a well-made roof would be from four to eight mats thick.

An almost equally common form of thatch was made from leaves of the breadfruit tree. Long straight upland reeds, or occasionally hard-wood shoots, were gathered and the leaves were strung on these by holes pierced at the juncture of the stem and leaf, the top of one leaf resting against the bottom of the next. These rods were then attached to the rafters in overlapping rows in the same manner as the mats. When in position the leaves stood edgewise on the roof. Thatch of this sort, although shaggy and rather unpleasing in appearance, is very effective and is said to outlast that of coconut mats. Where bread fruit leaves were used for thatching, coconut mats were usually substituted for the first two or three rows.

In ancient times a third form of thatch, made from palmetto leaves was used. The leaves were strung on light rods at intervals of twelve to eighteen inches, the rod passing from side to side through the juncture of the leaf and stem. The rods were tied to the rafters so that the leaves lay flat and overlapped like shingles. According to informants palmetto was commonly used to thatch the houses in *me'ae*, but was not tapu for other structures. The only example seen was on the front roof of an old chief's house in Ua Pou.

The use of pandanus for thatch is mentioned by Jardin (33, p. 51), who says that this material lasted longer than either coconut mats or breadfruit leaves, but the practice is now obsolete and only one fragment of doubtful authenticity was seen. This fragment, found in the debris of a house of Tahitian form, consisted of a hardwood rod over which the leaves had been doubled, with the two ends pinned together by a splinter a short distance below the rod. A somewhat similar technique is followed in the making of sugar cane thatch in Tonga.

Grass was very rarely used for thatch but the chief of Tetai, one of the small side valleys in Atu Ona, Hiva Oa, is remembered as having occupied a grass-thatched house, the frame of which was of ordinary Marquesan form.

The method of closing the peak of the thatched roof was very simple and effective and is still employed for all thatched roofs. In the crotch formed by the crossing of the small rafters above the ridgepole, a small pole was laid with its top flush with the rafter ends. Several layers of coconut mats were then laid longitudinally over this and bent down on either side so that their lower edges extended some distance below the top of the last tier of thatching. These mats were then secured in place by long wooden splints passed through them from side to

side between the main ridge pole and the small pole. On some houses a layer of pandanus leaves was laid over the ridgepole before the small pole was put on. These leaves were then secured by an additional pole on either side of the roof placed in the angle formed by the intersection of the small rafters.

THE HOUSE WALL

The Marquesan house was substantially an open shed with the rear roof extending to the ground. The walls merely served to close the openings in the structure and could be removed wholly or in part without effecting the stability of the house. Work sheds and cook houses were unwallled, and it is probable that in former times some more pretentious structures were also quite open, for several end posts were seen that were carved on both sides. The outer side would have been invisible in a walled house. Most buildings were provided with end walls, although many ceremonial structures and even dwellings were open in front. The framework of the end walls usually consisted of four or more light poles arranged like the sticks of an inverted fan, with one end resting on the edge of the *paepae*, the other against the ridge pole. The mats or leaf-packed rods used at thatch were tied to these poles just as they would be tied to the rafters. When the ends were not thatched a number of bamboos or peeled poles about an inch and a half in diameter were lashed horizontally to the uprights. These poles were placed either touching or at intervals of about an inch, and were cut to fit accurately the width of the aperture. In some houses the upper part of the end walls was of thatch, the lower part of poles. (See Pl. XL, C.)

The entire front wall with the exception of the door space was occasionally covered with thatch, but the practice does not seem to have been common. In a house visited in Hokatu, Ua Huka, one-half of the front was thatched with coconut mats; the other half was left open. As a rule, however, the front wall consisted of a series of separate units or panels each of which filled the space between a pair of front posts. These panels were made of bamboos or peeled poles about an inch and a half in diameter. In all the front walls seen the poles were placed side by side and fastened together by cords running over and under so as to form a sort of heavy pole-mat flexible laterally but not longitudinally. (Similar pole-mats were used as coffin covers in Hiva Oa and Fatu Hiva.) These mats were then strengthened by three crosspieces lashed to the back, at right angles to the poles and at equal intervals. The panels were usually placed between the posts in such way that the crosspieces were horizontal, and fitted into notches cut in the sides of the front posts, but occasionally they were placed with the braces vertically, the poles of the mat then being horizontal. In one house two light poles running from the door posts to the end of the house were added on the outside, but these were not attached to the panels.

THE HOUSE DOOR

No doors of the ancient type have survived, but good descriptions were obtained from informants. The doorway was normally in the middle of the front wall, the central pair of posts being placed relatively close together to form the jambs, while the top stringer of the wall formed the lintel. In many houses, however, a separate lintel was placed some distance below the stringer. The doorway was then so low that a person entering was compelled to bend almost double. The object of the low doorway was purely defensive. Both high and low doorways were used in all the islands in ancient times. Two forms of door are said to have been used with the high doorways. One of these consisted of two coconut leaf mats of the sort used for thatch, one of which was tied to either door post. To close the aperture the edges of the mats were drawn together and tied. The second form of door was made by planting two strong posts in the house floor, one close behind either doorpost; two heavy planks, as high as the doorway and more than half as wide, were then hewn from breadfruit wood and placed between the door posts and inner posts on either side of the doorway, the whole forming a crude double-leafed sliding door. To close the door the two planks were slid out from either side of the doorway meeting the middle. Stewart (59, pp. 233-236) speaks of "a small door in the middle, furnished with a shutter, in a slide, to be closed or opened at pleasure." Informants in Hiva Oa said that the small doorways there were provided with a single-leafed sliding door, although the exact arrangement had been forgotten. According to informants in the valley of Pua Ma'u, Hiva Oa, the doorways, whether high or low, were arranged with inner posts, like those already described, but were closed by laying a number of timbers of breadfruit wood, one above the other, in the space between the front posts and inner posts.

INTERIOR ARRANGEMENT OF THE HOUSE

The interior of the house consisted usually of a single room, without partitions, but Kruesenstern (34, p. 161) and Gracia (28, p. 123) both say that in the better houses one end was divided off by a bamboo partition and was used as a storeroom for valuables and Handy (32) reports tapa curtains called *kahu pahee ioto* sometimes used in Nuku Hiva. There was no furniture; even the stools used by some of the other Polynesian groups were lacking. The bed formed an integral part of the house. A strip comprising the rear half of the house-floor was left unpaved at the time of the construction of the *paepae*, and this was leveled and filled with soft earth, free from stones, until its surface was six to eight inches below the paved forward portion of the house-floor. Two carefully dressed palm logs eight inches to a foot in diameter were then laid along either edge of the depression. The straightness and polish of these logs were the pride

of the owner of the house. Two short additional pieces of palm log sometimes were laid transversely at either end of the bed space, just within the bottoms of the end posts of the house; rarely the log along the back of the bed space was omitted. The space enclosed by the logs was first filled with a thick layer of tips of palm fronds, or with ferns. Over these were laid several coconut mats, similar to those used for thatching. The mats at the rear were occasionally placed over the back log and tied to the rafters at a height of about eight inches (Pl. XL, *E*). Over the coconut mats in turn were laid woven pandanus mats of two kinds. Those covering the front part of the bed were called *moena*, and were woven of broad strips, three-eighths of an inch or more in width. Mats of this sort were tapu to men, and the use of the word *moena* as a term of reproach is known to have led to at least one murder in recent times. The rear part of the bed was covered with a mat of finer weave, called *kahua'a*, which was not tapu to men. The *kahua'a* was long and narrow, a single one usually running the entire length of the house. It was so placed that it covered the rear half of the *moena* and the back log of the bed. The outer edge of the *kahua'a* was tied up to the rafters. A narrow mat for the head alone, called *pa'i pa'i*, was sometimes placed over the *kahua'a* to prevent its being stained by the oil with which the natives soaked their hair.

Occupants of the bed lay with their heads toward the wall, the *kahua'a* supporting the head and shoulders and the *moena* the lower part of the body. With persons of ordinary height the feet projected over the inner log and rested upon the bare stone pavement.

The elaborate pillows found in some parts of Polynesia were not used in the Marquesas, but a pad of tapa was sometimes tied to the rear log of the bed under the *kahua'a*. Portable pillows called *nouni*, made from bundles of shredded *fei* leaves wrapped and tied with tapa, were also used.

According to informants a special form of bed was used at Pua Ma'u, Hiva Oa in the houses of a fishermen's sacred place, and by at least some of the priests. This bed consisted of two or more pairs of short posts, connected at the top by crosspieces, supporting a layer of small closely spaced poles. The whole formed a long rectangular bench, or shelf, raised eighteen inches to two feet above the ground. Four elaborately carved wooden legs in the Bishop Museum may belong to a bed of this type. (See Pl. XLI, *A*.) In the fishermen's sacred place each of the houses, which were very small, contained two of these beds, one along either side. Priests, after they had eaten of the sacrifice, continued to live with their families when not engaged in religious rites, but slept in a separate raised bed built for them in the common dwelling. Only coconut mats were used upon the beds of priests and fishermen, due to the ceremonial uncleanness of bed mats

of the ordinary type. It is probable that a single idea of defilement by contact with the ground underlay this use of elevated beds and the construction of the *fata'a* and *tona pou*, (pp. 294-5). It is interesting to note that in Tonga according to McKern (41) the bed of the Tui Tonga was always elevated, although it appears to have simply been built up with rolls of tapa.

HOUSE DECORATION

In the Marquesas most dwellings and practically all ceremonial structures were decorated to some extent. The *paepae* might be decorated with ornamental masonry, with figures carved in relief on the *ke'etu* facing of the raised house floor, or with small stone statues. In the house proper the decorations consisted of carved posts, ornamental lashings and occasionally of pigs' skulls. The use of human skulls as house decoration is doubtful.

DECORATION OF THE PAEPAE

The use of ornamental masonry in dwelling *paepae* seems to have been limited to the island of Nuku Hiva. There many of the house platforms had a row of *ke'etu* built into the front wall one or two feet below its top. The *ke'etu* were laid flat, with the long edge out, and from a little distance gave the effect of a narrow horizontal stripe or band—the regular width and reddish color contrasted pleasantly with the darker tint of the rough stones forming the bulk of the platform. *Ke'etu* so placed may have helped to tie the wall firmly to the earth and rough stonefill of the *paepae*, but long rough stones would have served equally well. In view of the labor required to quarry and transport the *ke'etu* it seems probable that their purpose was purely ornamental, and a proof of the wealth and influence of the owner of the house.

Some of the large dressed slabs of stone which faced the front of the raised house floor were carved. Two examples were noted: one in the valley of Haka Moui, Ua Pou; the other in the valley of Pua Ma'u, Hiva Oa. The Haka Moui site (32) is very unusual. The *paepae* was built with steps in three levels, one faced with large *ke'etu*. The *ke'etu* of the highest step were decorated with a zigzag pattern of ornamental adzing, and several of the other slabs bore full *tiki* figures or heads carved in very high relief. It is said that this structure was the residence of a chief; and became a *me'ae* upon his death. The decorations on the *ke'etu* of the Pua Ma'u site were much less elaborate; the main decoration of its *paepae* consisted of inset stone figures. On the upper side of one of the slabs facing the house floor a turtle, five inches long, was carved in low relief. The projecting end of the same slab bore a curious oval knob near the top and a beak-like projection at the bottom. This end carving is suggestive of a tenon for the attach-

ment of another slab, but as it projected beyond the end wall of the *paepae*, which was still in good condition, the carving was probably ornamental.

The use of stone figures for dwelling *paepae* was observed only in the valley of Pua Ma'u, Hiva Oa, although certain structures in Tai-pi Vai, Nuku Hiva, which were decorated in this way may have been the house *paepae* of religious personages. The Pua Ma'u *paepae* were certainly the dwellings of chiefs, and had been occupied as residences within the memory of persons living in 1920. In all of them the decoration consisted of three stone figures which were inset between the large *ke'etu* facing the raised rear section of the *paepae*. One of the figures was placed approximately in the middle, and the other two on either side about midway between the central figure and the ends of the platform. The heads of the statues projected wholly or in part above the level of the house floor, and in one instance the head had been carved in full round. All the other figures were carved in half to three-quarters round. A tenon approximately two-thirds of the width of the body was left on the back of the figures. The slabs adjoining the figures fitted closely against the tenons on either side so that when seen from the front, the statues appeared to stand in front of and against the wall rather than to be incorporated in it. (See Pl. xli, D-E.) The faces, with the exception of one unfinished figure, were of the usual highly conventionalized Marquesan type, while the carving of all the figures was remarkably fine. The statues in one *paepae* are known to have been made in a neighboring valley and brought as gifts to the chief of Pua Ma'u at the time he built the house less than a century ago, but these figures represent the highest development of the Marquesan sculptor's art. They are truly admirable in both design and execution and prove that this phase of the native culture was anything but decadent at the time of the European conquest.

DECORATION OF THE HOUSE

The most important features of the house decorations were the carving of certain parts of the frame and the use of ornamental sennit lashings. In the carved decoration two distinct techniques were employed—the timbers were either sculptured into human figures, or ornamented with non-naturalistic designs.

HUMAN FIGURES

The end and front posts of most ceremonial buildings and of at least some chiefs' dwellings were carved into human figures (Pl. xli, B). A number of examples were seen, but only one site was visited in which the original position of the figures could be determined. In this structure, which was certainly ceremonial, the figures supporting the ridgepole had been placed with their faces toward the interior of the house. The corner posts of the front wall also faced inward;

the other front posts faced outward. A small figure on the end post of a mortuary house also faced inward. It seems probable that this was the usual arrangement for end posts. The human figures were carved in full round, the convention employed being substantially the same as that used in the large idols of wood and stone. The heads were cylindrical, with flat faces upon which the highly conventionalized features were carved in low relief. They were finished at the top with a narrow horizontal band, above which a cylindrical neck considerably smaller in diameter than the head, supported the ridgepole or stringer. The ears, shaped like the chord of a circle, were shown as two thin flanges, projecting from either side of the head slightly behind its center. The forward surface of these flanges was carved with two scrolls of unequal length, the upper one being longer. The scrolls met at a point in line with the outer corner of the eye. In some figures a hole was pierced through the center of the lower scroll. A figure seen in Atu Ona, Hiva Oa, differed considerably from these. The roof timber of this house had rested directly upon the head of the figure without any intervening band or neck. The head was narrow, and short vertically with a marked occipital projection. The face was directed upward at an angle of about 35 degrees, and the features, although much weathered, indicated a high nose and generally naturalistic treatment.

The heads of the figures in a building usually showed uniformity in treatment and size, but the proportions of the body varied considerably, not only between the end and front posts but even between individual front posts. In the end posts the bodies and legs were unnaturally elongated, the idea evidently being to have the figure cover as much of the post as possible. In the front posts (Pl. xLI, *B*) the bodies were long and the legs disproportionately short or even lacking. The bodies as a rule showed little attempt at modeling, and were formed by a few simple planes; the arms were usually at the sides with the hands resting on the stomach. Both the upper arm and forearms were disproportionately short, and showed no attempt at modeling. The space between the upper arm and body in most figures was pierced, while the forearm was carved in rather low relief upon the body. In one specimen the hand was raised to the mouth and the upper arm was shown in the usual vertical position while the forearm and hand were unnaturally elongated; the space between the forearm and chin was pierced. The legs were always shown in a semi-flexed position with the space between them pierced. The thigh was usually short and the lower leg disproportionately long and heavy, but in the specimen from Atu Ona, the legs are naturally proportioned and well modeled. The feet were rarely indicated. The sex was usually shown but conventionally and without exaggeration of the parts.

The end post of a small mortuary house was decorated at the bottom with a small caryatid figure less than two feet high. The undecorated upper part of the post, which was of the ordinary triangular form, was nearly eight feet in length. No other specimens of this sort were seen and the form was probably uncommon.

CARVINGS ON POSTS

The use of house posts carved with non-naturalistic designs was quite common in Hiva Oa, Tahu Ata and Fatu Hiva. Only one doubtful example of post carving was seen in Nuku Hiva and Stewart's excellent description of the dwellings of that island makes no mention of this sort of decoration although he speaks of ornamental lashings (59, pp. 233-6). An informant of Ua Huka said that the house posts on that island were never carved with designs although he remembered the use of ornamental lashings and described them in some detail. It seems probable, therefore, that this type of decoration was little used in the northern islands of the group.

House posts decorated with carved designs retained their original rectangular or triangular cross section, the designs being rather shallowly incised upon the flat surfaces (Pl. XLI, C). Front posts were usually carved on the outer and inner sides; the lateral surfaces were left plain. Most end posts were carved on the flat inner side only, but a few were observed in which the two outer surfaces were also decorated. No two posts were exact duplicates, but all the posts from a single house showed more or less uniformity in the motifs employed. This was probably due to their being the work of a single artist.

Some of the posts had been carved with metal chisels, but originally the designs appear to have been hewn upon the posts with a special form of narrow-bitted adz. With this implement the artist worked free hand without a model, which accounted for the coarseness and irregularity of much of the work. The designs were never continuous from top to bottom, but were applied in horizontal zones of varying width. On a few posts there was a suggestion of an additional longitudinal division of the surface into two equal parts. The two surfaces of the outer sides of end posts were ordinarily treated as separate units. The grooves of the carving were usually semicircular in cross section, the raised surfaces between them being narrow and sharp edged. In some curvilinear designs small uncarved spaces were left, but as a rule the artist showed no appreciation of the value of plain surfaces and covered every inch of available space with carving.

In carving house posts angular-geometric and curvilinear patterns were used, but on analysis the number of motifs proved to be small. The designs in the posts studied may be given as follows:

ANGULAR-GEOMETRIC DESIGNS

1. Straight horizontal lines. Bands of these were used to separate zones of more elaborate design and also to fill zones. This motif with its variations is shown in Figure 4, *a, b, c, d*.
2. Straight diagonal lines. Used to fill zones (fig. 4, *e*).
3. Series of parallel zigzag lines running horizontally (fig. 4, *f*).
4. Bands of alternate interlocking triangles (fig. 4, *g*).
5. Groups of four triangles whose bases are formed by the sides of the zone. The interiors of these triangles are filled with lines parallel to the base, lines parallel to one side, or a series of V's whose sides are parallel to those of the triangle (fig. 4, *j*).
6. Large diamond shaped figures covering the length and breadth of a zone, leaving four triangles at the corners (fig. 4, *k*).
7. Small diamond shaped figures arranged in close order to fill an entire zone (fig. 4, *h*).
8. Irregular combinations of diagonal lines (fig. 6, *d*).

The Marquesans appear to have never used checkerwork, patterns formed of groups of small triangles, or cross hatching, in their house post decorations.

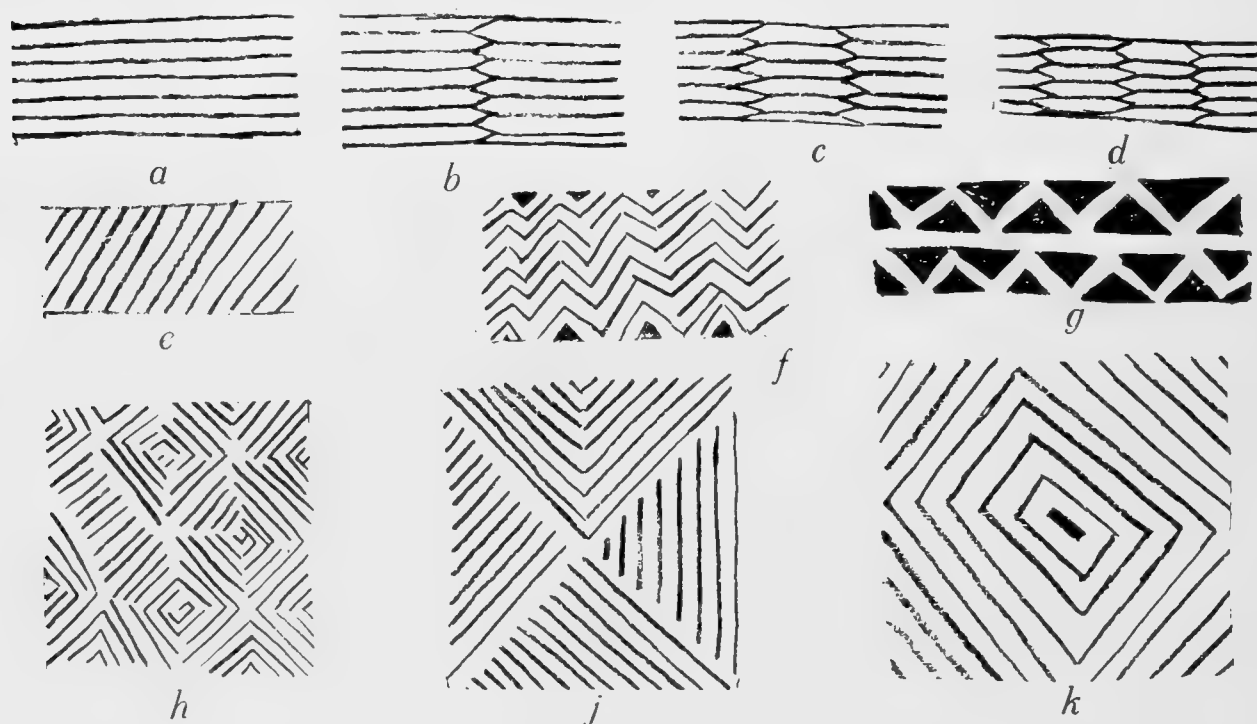


FIGURE 4.—Angular-geometric designs carved on house posts: *a*, straight horizontal grooves; *b*, horizontal grooves with length equal to one-half the width of the post; *c*, horizontal grooves with length equal to one-third the width of the post; *d*, horizontal grooves with length equal to one-fourth of the width of the post; *e*, diagonal lines; *f*, parallel zigzag lines; *g*, interlocking triangles; *h*, small diamond shaped figures. *j*, groups of four triangles; *k*, large diamond shaped figures. Reproduced from rubbings.

CURVILINEAR DESIGNS

The curvilinear designs used in house post decoration may be reduced to a few simple elements, but these are combined with each other and with angular-geometric designs to form a bewildering variety of patterns. The basic elements are:

1. Circles, either single or in concentric series (fig. 6, *a*).
2. Ovals, either single or in concentric series (fig. 6, *b*).
3. Portions of circles and ovals, either plain or filled with lines parallel to the circumference, (fig. 5, *c, d, e*).
4. Series of parallel wavy lines (fig. 5, *b*.)
5. Irregular curves (fig. 5, *a*.)

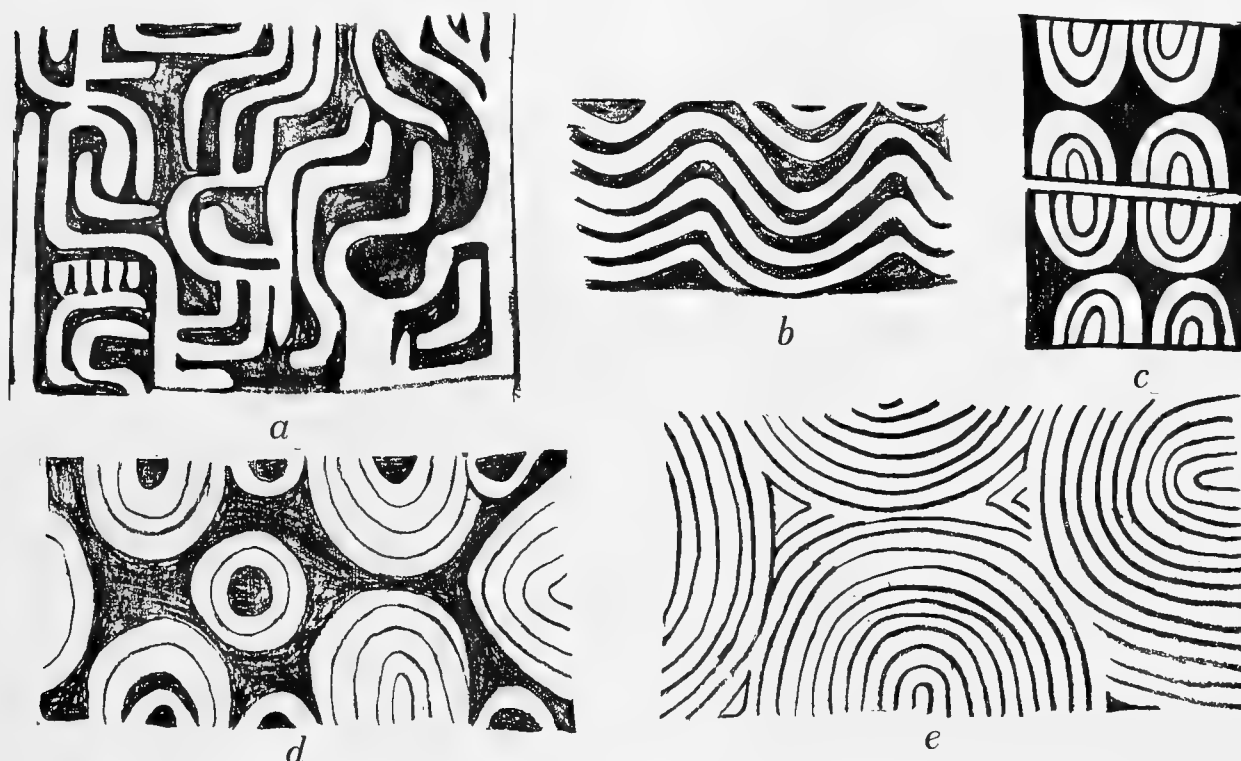


FIGURE 5.—Curvilinear designs carved on house posts: *a*, irregular curves; *c, d, e*, segments of circles or ovals; *b*, series of parallel wavy lines. Reproduced from rubbings.

When used in patterns the arrangement of these design elements is never perfectly symmetrical, although in some designs, notably those formed by four semicircles or semiovals (fig. 5, *a*), there is some approach to balance. Many of the patterns consist almost entirely of irregular curves and are completely unsymmetrical, no two elements corresponding in size or position. Interesting features of the curvilinear decoration are the complete absence of the conventionalized human faces used in all other forms of Marquesan carving and the practical absence of spiral forms.

COMBINED ANGULAR-GEOMETRIC AND CURVILINEAR DESIGNS

Angular-geometric and curvilinear designs frequently occur together in the same zone, the common arrangements being:

1. Curvilinear designs, especially concentric circles or ovals, superposed upon angular-geometric designs (fig. 6, *a, b*).
2. Curvilinear designs used to fill one or more of the elements of a geometric pattern.
3. Gradual transitions from angular-geometric to curvilinear designs, as in the case of some bands of parallel lines which grade imperceptibly from zigzags at one end to wavy lines at the other. In all such combinations the angular-geometric motifs appear to be the basic ones.

An interesting feature of the house post carvings is the occasional use of toothed lines suggestive of those used by the Maori in many of their carvings. Examples of the use of such lines are shown in figure 6, *c*, *e*.

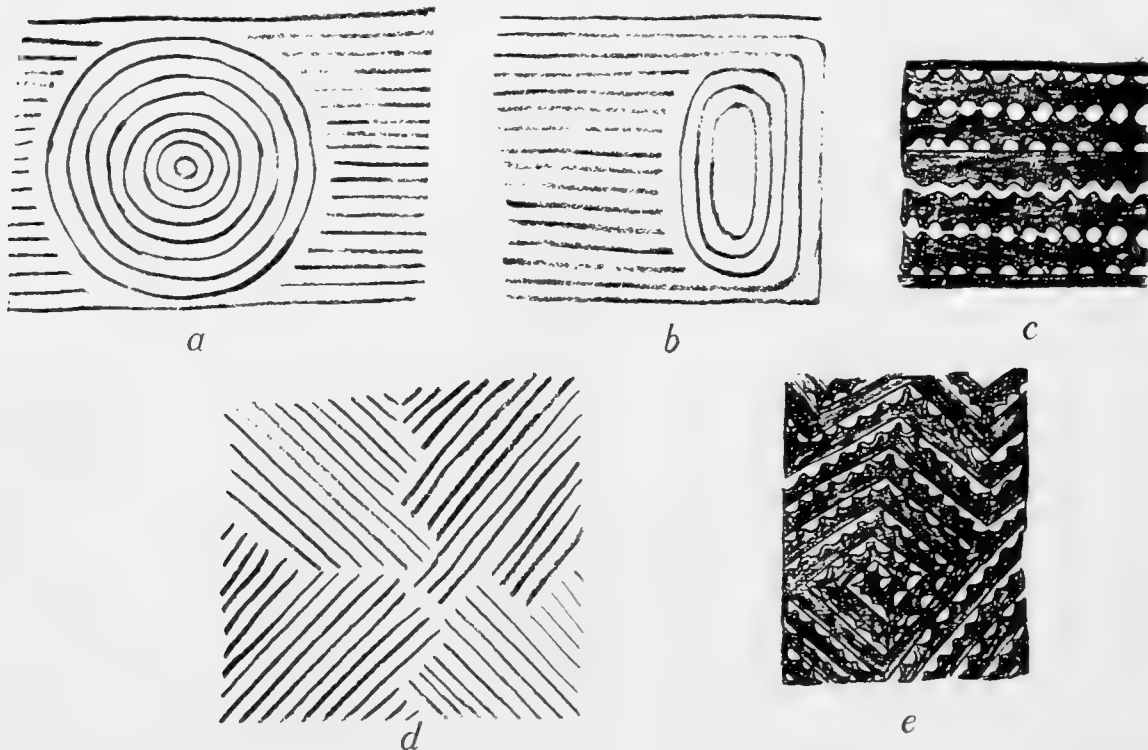


FIGURE 6.—Designs carved on house posts: *a*, circles superposed upon straight vertical grooves; *b*, ovals superposed upon straight vertical grooves; *c*, toothed lines; *d*, woven design; *e*, spiral with toothed lines. Reproduced from rubbings.

It is easy to conceive of the development of house post carving from an appreciation of the esthetic value of the adz marks left after the dressing of the timber. In many objects which are not actually carved these marks are arranged with evenness and regularity and give a decidedly ornamental effect. What may be considered as a intermediate stage between such adzing and actual carving was observed in a set of end posts from Nuku Hiva and another from Fatu Hiva. The inner surface of these posts had been adzed into a series of horizontal grooves six to eight inches wide with a maximum central depth of one-half inch, the ridges separating the grooves being narrow and sharp. The transition from such ornamental adzing to the simpler geometric designs would be easy.

ORNAMENTAL LASHINGS

Ornamental lashings were probably more commonly used as decorations for the house than carvings, but because of the perishable nature of the materials few examples have survived. The material employed for lashings was a

flat three-strand sennit plaited from coconut fiber. This fiber was obtained from both the husk and the leaf sheath. The sheath fiber was considered the better, probably because its greater length rendered possible a smoother plait. The only colors seen were a dull black and the natural red brown, but Stewart (59, p. 236) mentions the use of yellow and white sennit as well. The plaiting and dyeing of this sennit have been described on pages 378 and 379.

The only complete set of ornamental lashings seen in the Marquesas was in an old house in the valley of Atu Ona, Hiva Oa. The lashings were applied to the juncture of the three main rafters of the front roof with the ridge pole, to the junctures of all the rafters of the front and rear roofs with the lowest crosspieces, and to the junctures of the main rafters of the rear roof with a squared beam which ran along its under surface at the height of the top of the front wall. This top beam probably did not exist in really primitive structures. According to informants, ornamental lashings were used for the attachment of the front posts to the stringer, of the main rafters of the front roof to the stringer, and of all the cross poles of the roof to the rafters. Stewart (59, p. 236) says that the front posts were "generally neatly hewn and ornamented by braids of sennit . . . tied on in horizontal stripes in diamonds or in checks, in a pretty and fanciful manner." As the front posts in Hiva Oa, Tahu Ata and Fatu Hiva were usually carved this was probably a Nuku Hivan practice. The posts of houses in Nuku Hiva are also said to have sometimes been covered with white tapa under the lashings.

A considerable number of lashing designs were employed but their use has been discontinued for many years and only two patterns were seen. These appeared on different parts of an old house in Atu Ona. According to informants the designs used for house lashings were made by a special *tuhuna* who originated them from string figures. Different designs were used for the front posts, the rafters, and for other structural parts. Another special *tuhuna* put them on. The designs seen were ovals with a black center and brown rim, used at the points of attachment of the small rafters and the cross pieces of the front and rear roofs (Pl. XL, *F*), and crosses with a band on either side, used at the juncture of the main rafters with the lowest crosspiece. At the juncture of the central rafter of the front roof with the ridge pole two of these designs were placed side by side.

METHODS OF MAKING LASHINGS

The methods of making lashings may be described as follows:

For the oval lashings two cords were used, one of black and the other of brown sennit, both being carried from the left along the top of the crosspiece. The black cord was passed twice around the rafter to form a double hitch whose upper and lower loops were respectively above and below the crosspiece. The cord was then turned back to the left, carried up the

left side of the juncture of the rafter and crosspiece, and around the rafter just above the crosspiece from right to left. The half hitch was tightened and the strand brought into a vertical position on the outside of the crosspiece. The loose end was then passed across the vertical strand as close to the rafter as possible, down its right side, across it again at the bottom, and behind the rafter from left to right. The flatness of the sennit cord prevented this loop from slipping over the vertical strand. The cord was carried across the original strand and the first loop as close to the rafter as possible, up the left side of the original strand, and across the original strand and first loop at the top, close to the rafter. The cord was then passed behind the rafter from right to left. This was repeated until the oval had a width of five strands at the center. The end of the cord was then at the upper left hand corner of the figure. It was passed across the lashing in front of the rafter, down the right side of the lashing behind the crosspiece, across its bottom and up its left side behind the crosspiece. This completed the black part of the figure. The strands were pulled taut and the black cord carried on in front of the rafter to the next rafter to the right.

The brown cord, coming from the left, was brought across the top of the black lashing in front of the rafter, down its right side behind the crosspiece, across to the left, and around the rafter from left to right. The end was then at the lower right hand corner of the figure. Two loops up, around the rafter, and down on the opposite side of the figure were then made, the method being the same as that used with the black cord. This gave to the oval a width of nine strands, the two outer strands on each side being brown and the rest black. The cord was then carried across to the left, up the left side of the lashing behind the crosspiece, and across the lashing again at the top, with the end carried on to the next rafter on the right.

The cross lashing was much more complicated. It can be made as follows: Bring the black cord from the left along the top of the crosspiece, pass it around the rafter from right to left, down over the crosspiece, around the rafter from left to right, up the left side of the rafter behind the crosspiece, and through the upper loop. Tighten lashing, pass the end down the left side of the lashing behind the crosspiece and up, over the front of the crosspiece, placing it close against the original outside strand on the left. Pass the end downward behind the rafter diagonally to the right, bringing it out at the lower right corner. Bring it up over the crosspiece diagonally to the left, around the rafter from left to right and diagonally down over the crosspiece right to left. Carry it behind the rafter from left to right, across the front of the rafter, and up the left side of the lashing behind the crosspiece. Wrap twice around the crosspiece and pass the end around the rafter below the crosspiece from left to right. Bring it up diagonally over the crosspiece from right to left, placing the cord close against the left side of the first diagonal. Pass the end around the rafter left to right, and bring it down over the crosspiece diagonally to the left. Pass around rafter left to right, across to left in front of rafter, and up left side of lashing, behind crosspiece. Leave black.

Bringing the brown cord from the left pass it over the black lashing below the crosspiece, up the right side of the lashing, back to the left, and under itself from the rear. Pull the loop tight. Pass the brown cord twice around the crosspiece, taking care to have these strands lie on the left of the four black strands already in position and close against them. Pass the end around the rafter above the crosspiece from right to left, diagonally down over the crosspiece from left to right, around the rafter from right to left, up over the crosspiece diagonally to the right, and around the rafter from right to left. Leave brown.

This finishes the first half of the figure, and should give a vertical band of six strands, the two strands on the left being brown, which has on its right an X figure with arms three strands in width, the first strand on the left side of each arm being brown.

Take up the black cord, which was carried up the left side of the lashing behind the crosspiece. Carry it across the lashing in front of the rafter, down the right side of the lashing, across the lashing again, and up behind the rafter diagonally left to right, the end emerging at the upper right hand corner. Bring it down over the crosspiece diagonally right to left, around rafter left to right, and up diagonally over the crosspiece right to left. Pass it down behind the rafter diagonally left to right. Wrap it twice around the crosspiece. Carry the end across the lashing below the crosspiece to the left, and up diagonally behind the rafter, emerg-

ing at the upper right corner. Bring it down over the crosspiece diagonally to the left, around the rafter left to right, and diagonally up, right to left. Pass it down behind rafter diagonally, emerging lower right corner, and wrap it twice around the crosspiece. Carry end across lashing below crosspiece to the left, up the left side behind the crosspiece, and across the lashing to the right, in front of rafter. This completes the black part of the lashing.

Take the brown cord, which has been carried around the rafter from right to left above the crosspiece, and carry it down over the crosspiece diagonally from left to right. Pass it around the rafter right to left, and diagonally up over the crosspiece left to right. Bring it down behind the rafter diagonally right to left, across the lashing below the crosspiece to the extreme right edge of the figure, and wrap twice around the crosspiece. Make one complete turn around the rafter below the crosspiece from right to left, carry up the right side of the lashing, across to the left, down left side and carry on to next figure on right.

The complete lashing should consist of two vertical bands each of six strands, the two outer strands in each band being brown and the four inner black. Between these there should be an X whose arms are six strands in width, the two strands along the edges of either arm being brown and the four central strands black.

OTHER FORMS OF DECORATION

No indication of the use of paint in the decoration of house timbers was found, and no reference was made to it by informants. Du Petit-Thouars (48, p. 347), however, speaks of seeing in the island of Tahu Ata, a small house, with posts painted red and yellow, which sheltered a corpse. This form of ornamentation was probably never used for dwellings.

Informants in Pua Ma'u, Hiva Oa, stated that men's houses belonging to chiefs were often ornamented with the lower jaws of wild pigs, several of them being attached to the inner side of the front stringer at regular intervals. The jaws were placed angle up, with the tusks projecting below the stringer. These tusks were useful as well as ornamental, serving as hooks on which to hang small objects.

The early accounts of the Marquesas contain several references to prepared skulls which were used to decorate the houses of victorious warriors, but no details of the arrangement are given and as such trophies were also worn as ornaments it seems probable that they were simply hung up in the house and not incorporated in the structure.

HOUSE FURNISHINGS

Although furniture, in the European sense, was lacking, miscellaneous objects were to be found in any inhabited Marquesan dwelling. The bed space was covered with mats; wooden bowls and boxes lay about; calabashes and baskets hung from the walls or ridge pole; and tools and weapons were hung up or were thrust into the thatch. Porter (49, p. 113) says that there were "stands, calculated to hang different objects on, so contrived that the rats could not get them" and "cradles for their children, hollowed out of a log and made with great neatness." No other reference to these cradles has been found. From the ridge-pole hung a number of bundles containing new tapa, or the gala dresses and

valuables of the occupants. As a protection from rats the cords by which the bundles were suspended passed through inverted gourd shells. The cords passed over the ridgepole and were tied at a convenient height so that to get a bundle it was only necessary to loosen the cord and lower away. The whole house was kept scrupulously clean and formed a healthy and agreeable dwelling.

SPECIAL HOUSES

In addition to the houses of the two main types already described, the Marquesans appear to have built a few special structures of slightly divergent form. No buildings of these minor types have survived; they must be reconstructed from the fragmentary accounts of informants.

The storehouse was not built on a *paepae* but was raised above the ground on four to six posts. It stood near the dwelling *paepae*, preferably at one end, and its floor was at about the same level as that of the house. It was a small structure shaped like a dwelling, but the use of a raised floor must have necessitated minor changes in construction which can not now be ascertained. The floor was made of fau poles. In the better storehouses the posts and frame work were carved and there was a liberal use of ornamental lashings. The house was used for the storage of tapu articles and was sometimes used as a residence by old men. It was tapu to women. The native name for this house was *fata'a*, a word whose resemblance to the Maori word *pataka* (applied to small elevated storehouses) is obvious.

Fisherman's houses were built within the precincts of the fishermen's sacred place. In Atu Ona, Hiva Oa, these houses were of special form according to information obtained by Handy (32). They were raised on posts like the *fata'a* already described. The floor was of fau poles and the roof was of the small house type. The ends of the house were closed and in one end, a small rectangular door was built. These houses must have been a local development, for the fishermen's houses in the valley of Pua Ma'u, on the same island, were not of this type.

Fae tukan were sacred structures erected in *me'ae*. They are mentioned by Gracia (28, p. 57) and by Porter (49, p. 111). Porter describes them as follows: "To the right and left of these gods are two obelisks, formed very fancifully and neatly of bamboos and the leaves of the palm and coconut trees interwoven. The whole is handsomely decorated with streamers of white cloth which give a picturesque and elegant appearance. The obelisks are about thirty-five feet in height."

According to information obtained by Handy (32) in Pua Ma'u, Hiva Oa, these houses were built by the *taputoho*, a revenge victim (*heana*) being sacrificed

and eaten as part of the ceremony. The house itself appears to have been of the ordinary dwelling type modified by greatly increasing the height of the roof. One house of this sort in Pua Ma'u is said to have been "three fathoms long, three fathoms wide, and ten fathoms high," but the height at least is almost certainly exaggerated. The end posts were made of several pieces of lumber spliced one above another and placed like those of an ordinary dwelling. There were three front posts. The front was open. The roof was thatched with breadfruit leaves and decorated with figures of birds made from red tapa and split bamboo, between which were placed *koufau* (bundles of sticks). There is said to have been a bird figure for every fathom of height. Within the house there was a *fata'a* called the *ananu'u*. The only other objects in the house were three pieces of wood placed one on the *fata'a*, one half way up the house, and another at the top. Each of these pieces of wood was decorated with four designs called *tava* which were so arranged as to form an open square. A *taputoho* lived in this house.

Tona Pou were houses tapu to women in which the men assembled to chant the *pue* (name chant). They are said to have been raised above the ground on posts and, according to Handy (32), were like the *fata'a* except for their larger size.

Canoe houses appear to have been purely utilitarian and did not exist in certain valleys because of the practise of carrying the canoes up into the *tohua* (assembly place) or of dismembering the canoes and distributing the parts among the various owners. They appear to have been most common in valleys having good beaches and the sites of the canoe houses in Pua Ma'u, Hiva Oa, are still remembered. An old man there, who had seen some of these structures, said they were open at one end, like the modern boat houses, but he could give no details of their construction. A modern house in the valley of Hatiheu, Nuku Hiva, suggested a possible form for these structures. One end of this house was like that of an ordinary dwelling. The other end was open. Two heavy posts of equal height were planted on either side. Their tops were connected by a heavy curved beam, convex side up, from the center of which a short vertical timber extended to the peak of the roof, supporting the ridgepole.

SUMMARY

The Marquesans employed two main house types, the canoe houses possibly forming a third. The simpler houses consisted of a roof resting upon the ground, while in the larger and more elaborate the roof was raised on one side only. Houses of the second type were normally built on terraces or platforms of stone which were often of considerable height. They were used as dwellings and sacred structures. When used for ceremonial purposes some of them were modified by

raising the entire house on posts, or by making the roof of disproportionate height. Houses of both types appear to have been used in all the islands, but the larger type shows more or less local variation in the form of the *paepae*, in size, and in decoration. In Nuku Hiva and Ua Huka the *paepae* was as a rule much wider in proportion to its length than in the islands further south and in Nuku Hiva many *paepae* were provided with a pit for tapu objects. The use of cut stone as edging for the house floor, although of sporadic occurrence in all the islands, was most frequent in Nuku Hiva and least frequent in Fatu Hiva. The decoration of the dwelling *paepae* with ornamental masonry appears to have been limited to Nuku Hiva, and its decoration with stone figures, to Hiva Oa, with a single doubtful example from Nuku Hiva. As a class the houses of Nuku Hiva were the largest in the group and those of Fatu Hiva, the smallest and most poorly built. Carved posts are said never to have been used in the dwellings of Ua Huka, were rare in Nuku Hiva, but were very common in Hiva Oa, Tau Ata and Fatu Hiva. Ornamental lashings were used everywhere in the Marquesas, but appear to have played a more important part in the decoration of houses in the northern than in the southern part of the group.

COMPARISON OF POLYNESIAN HOUSES

Structures corresponding to the Marquesan small house type (p. 271) are of rather wide occurrence in Polynesia. They are recorded from Hawaii, where they represent the original form from which the other house types were developed. They are also found in Tonga and in the Society Islands. The dwelling house type, as described on page 272, is characteristic of the Marquesas, and so far as known is peculiar to that group of islands.

It seems probable, therefore, that the original settlers of the Marquesas brought with them a knowledge of the small house type and that the dwelling type is a later local development. The small house, while easily made, was inconvenient on account of the lack of head room and the large amount of waste space under the edges of the roof on either side. To develop the dwelling type from the small house type it was only necessary to raise the roof on one side and prop it up with posts placed along the outer edge. Even now small houses are occasionally enlarged in this way. The use of a stringer along the front of the house to keep the rafters from sagging between posts would be a step requiring no great inventive genius, while an increase in the pitch of the rear roof, cutting down the waste space along its lower edge, would soon follow. The complete absence in the Marquesas of houses with both front and rear walls is rather curious as the natives were in occasional contact with the Tuamotus and Society Islands, where walled houses were in regular use.

On the basis of house type, Polynesia as a whole may be divided into two parts: a central part, including Tonga, Samoa, and to a lesser degree the Society Islands, in which the houses were oval, with rounded apses; and a marginal portion including New Zealand, the Marquesas and Hawaii, in which the houses were rectangular. In the central section there was no distinction between floor space and bed space, and the platform was unimportant. Some of the houses were furnished with wooden stools. Legged pillows of wood or bamboo were in regular use. In the marginal section there was a permanent division of bed and floor, a stone platform was used everywhere but in New Zealand and there was no furniture.

The Marquesan house had little in common with the central Polynesian type, and appears to be intermediate in form between the two varieties of the marginal type—that is, the Maori and the Hawaiian. In the arrangement of the frame and the common use of a stone platform and side entrance, it resembles the Hawaiian form. On the other hand the use of carved decoration links it with the Maori form, as does also the occurrence of a slide door. The *fata'a*, or store house on poles, finds no parallel in Hawaii or central Polynesia, but it closely resembles the Maori *pataka*. The use of ornamental lashings is absent in both Hawaii and New Zealand, but is highly developed in many parts of the central area. The best explanation for these facts appears to be that the Maori, Marquesan and Hawaiian forms are descended from a common ancestor, but that the Maori and Marquesan houses have been affected by some influence which introduced house carving and the *fata'a* type of structure, an influence which did not reach Hawaii. The Marquesan houses were then further modified by the introduction of ornamental lashings, a feature which did not reach either Hawaii or New Zealand.

CANOES

For convenience in description, Marquesan canoes may be considered as of two main classes, modern forms, all of which show more or less European influence; and ancient, or genuine, Marquesan forms. The modern canoes are of two sorts, small fishing canoes and the form called by the natives *vaka poti* (literally, canoe boat), which is a hybrid of the European boat and the native canoe. Only two types of ancient canoe are remembered by the present natives, a small fishing canoe closely resembling the modern one, and a large war canoe. Double canoes, as described by informants, cannot be said to constitute a distinct type. Porter (49), who gives a very good account of the canoes used in Nuku Hiva at the time of his visit in 1813, describes a third type, all memory of which seems to have been lost. He also mentions a form of large double canoe used for long voyages.

MODERN CANOES

FISHING CANOES

Small fishing canoes are still in constant use throughout the Marquesas. Their structure and method of manufacture may be described as follows:

They range from twelve to eighteen feet in length with a beam of one foot to eighteen inches and a depth of about eighteen inches. The body of the canoe is hewn from a single log of breadfruit wood which is usually peeled and allowed to season for a time before shaping, but the making of some canoes begins as soon as the tree is felled. The shaping of the outside is completed before the excavation is begun. When the log has been roughly excavated with an ordinary steel axe, a short handled adz with a semicircular cutting edge is used to complete the dressing. The natives are remarkably expert in the use of these adzes, and the cuts left by them are as regular as though made by machinery, even on surfaces that will later be rubbed smooth. The outside of the canoe is rubbed down with sand paper after shaping until all the adz marks are obliterated. In the finished body, the sides are three-quarters of an inch to an inch thick, and the bottoms are from an inch to an inch and a half thick. The sides run parallel for most of the length, beginning to taper inward two to three feet from either end. The bow and stern are indistinguishable, the bottom curving up for about one-third the depth of the body and passing imperceptibly into a straight cutwater. After the body is completed, two holes are bored through each side directly opposite about two inches below the gunwale edge and about three feet from the bow and from the stern. Round pieces of hard wood about three-quarters of an inch in diameter and seven inches long are then driven through these holes forming plugs which are used in the attachment of the outrigger. Two half-inch planks, four to six inches in width, are then placed outside the body, their lower edges resting upon the projecting plugs, and are gradually bent inward at either end, following the curve of the body, until they meet at the bow and stern. The ends of these planks are sawn diagonally to make the joint as tight as possible. These planks are nailed to the body of the canoe and to each other. Small triangular pieces of plank, resting upon the top of the dugout underbody, are usually inserted at bow and stern, forming a short deck at either end. Ordinary commercial hard pine is used for these and for the side planks. No caulking is used; the joints between the body and the sides planks are sealed with several coats of paint.

All canoes are provided with outriggers. The form now in use, which has replaced the original form throughout the group, is known to be the invention of a mulatto who settled in the valley of Tahuku, Hiva Oa, a few years ago. The rapid dissemination of this invention

indicates the speed with which new appliances of obvious value are accepted by the natives. The new outrigger is indirect, and consists of three elements, the float, the uprights, and the crosspieces. The float consists of a peeled log of fau wood four to five inches in diameter, slightly shorter than the canoe. This is usually sharpened at the forward end only, the cutting being done entirely from the lower side, but a few specimens were seen which had been sharpened at both ends, apparently with the idea of making the canoe completely reversible. The uprights, about two feet long, are usually made of small barrel staves. A triangular notch about two inches deep is cut in the upper end. Eight inches below this notch the uprights are pierced by a rectangular hole an inch and a half to two inches square. These uprights are permanently attached to the float. The unnotched ends of the staves are wedged into longitudinal slits near either end of the upper surface of the float. The crosspieces are peeled poles of fau or hard wood about eight feet long and three inches in diameter at the butt. Their outer ends are sharpened so that they will readily pass through the rectangular holes in the uprights.

The outrigger is assembled and attached as follows: The squared ends of the cross poles are fitted into the holes of the uprights, their points projecting about two inches on the outer side. The whole outrigger is then placed on the right side of the canoe, the crosspieces extending across it on the line of the hard wood plugs, with their butts projecting a few inches beyond the left gunwale. One end of a light rope is then fastened to the projecting end of the front crosspiece, outside the upright. The rope is then carried over the top of the upright, through the notch, and along the crosspiece to the inner side of the right gunwale. It is then passed back and forth diagonally over the crosspiece and around the inside and outside ends of the plug until the crosspiece is held rigidly. The rope then runs along the crosspiece to the left gunwale, where the same lashing is repeated. Some slack is then left in the canoe, and the left end of the rear crosspiece is lashed, the rope passing from there to the right gunwale lashing the crosspiece there, and out along the crosspiece and over the end of the upright to the outer end of the crosspiece, where it is tied. Any rope left over is carried back along the crosspiece and coiled in the canoe.

An outrigger of this sort can be attached or removed in a few moments, and the single rope used to lash it is available for other purposes when not in use on the canoe. When a canoe is beached the owner usually removes the outrigger at once and stores it in a safe place, thus making the canoe useless and safeguarding it from theft.

Small fishing canoes of the type described are rarely used for trips of any length. They are not sailed but are commonly paddled by two men. One man sits on the stern crosspiece of the outrigger where it crosses the boat, while the other wedges himself between the thwarts amidships. Most of these canoes are completely reversible, and they are sometimes paddled with the outrigger on the left instead of the right. The narrowness of these craft, and their high center of gravity (for the paddlers sit practically on top of the canoe) make them very unstable, and in spite of the outrigger they frequently capsize. The natives right them by getting on the outrigger and forcing it down under the canoe and up the other side.

VAKA POTI

The *vaka poti*—a craft that appears to be a local development—is an interesting example of the native adaptation of European ideas. It may be described as follows:

As the name indicates, the *vaka poti* is a hybrid of canoe and boat, and is larger and more seaworthy than the fishing canoe, being twenty to twenty-five feet long with a maximum beam of two to two and a half feet. A long trip of breadfruit or temanu wood, eight inches to a foot in width, about four inches thick and tapering to a point at both ends, serves the double purpose of keel and bottom. It is smoothly rounded on the outside and slightly hollowed along the center of its upper surface. This is probably an extreme modification of the dugout underbody of the old built up canoes. Longitudinal slots are cut in either end of this keel and into these two flat, slightly curving pieces of temanu wood are bolted. These serve as the stem and sternposts of the boat, and are identical in form. Short light ribs are then bolted to the keel along both edges, their short lower arms resting upon its upper surface. The sides of the boat are built up with thin planks of commercial lumber which are laid on with an overlap from above downward—that is, the boat is clinker built. These planks are carefully dressed along the points of contact to insure a tight joint, and are fastened into grooves in the sides of the stem and sternpost. The gunwales are finished with a narrow flat strip of wood. At either end of the boat, immediately below this strip, a triangular piece of plank is put in, decking the last two or three feet of the bow and stern. The boat is braced by three broad flat thwarts which also serve as seats. One of these thwarts is placed in the middle and the other two at either end, two to three feet within the edges of the end deckings. The forward thwart is pierced with a hole three or four inches in diameter which, with a corresponding block on the keel, serves to step a mast. These crafts are always provided with an outrigger similar in shape and attachment to that of the fishing canoe, but of proportionately greater size.

Alexander, who visited Nuku Hiva in 1899, saw a slightly different form of outrigger in use with the *vaka poti*. He says (2, p. 746): "From the gunwale to the outrigger float of these canoes is an average of 7 feet. The outrigger frame consists of five pieces of wood, namely, two poles or crosspieces seized across the gunwales $4\frac{1}{2}$ feet apart, one forward and the other aft of center; two stanchions connecting crosspieces of the outrigger float, and a brace which is seized to crosspieces just outside the gunwale. That part of the crosspieces between the gunwales answers the purpose of thwarts, the upper side being hewn to a flat surface. The outboard ends are sized to the perpendicular pieces, or stanchions, the length of which is, as a rule, the distance from the gunwale to the water line. These pieces are sized to the top side of the float, the sizings extending all the way around the float, but done so neatly as to offer little resistance to the water. The crosspieces, float, and stanchions are braced with withes to prevent them from being twisted and thrown out of position by coming in contact with rocks. . . . The material used in sizing the outrigger frame together is coconut fiber twisted into a small line."

A *vaka poti* is normally handled by four men, one of whom sits in the stern and steers with a paddle while the other three row with short oars of ordinary European form. The bow and stern oars are placed on the side opposite the outrigger, the middle oar on the outrigger side, working within it.

Every craft of this sort is provided with a leg of mutton sail of canvas like that commonly used on ships' boats. When not in use the sail is stored under the short deck at one end of the boat, while the poles which serve as mast and boom are lashed along the crosspieces of the outrigger. The heavier of these poles, which is about nine feet long, serves as the mast. When the sail is to be hoisted, the mast is passed through loops of string tied along one edge of the sail, the loop nearest the masthead being firmly tied to the pole. Two light ropes are then attached to the masthead opposite each other and the mast is stepped, the butt passing through the hole in the forward thwart and resting in the hollowed block in the keel. The two ropes from the masthead are then fastened to the forward outrigger crosspiece just outside the gunwales of the canoe. A third rope is sometimes run from the masthead to the prow, but this is not common. The lighter pole serves as the boom and passes through the loops along the lower edge of the sail. The outermost loop is firmly tied to the boom, and a rope is attached to its outer end. The boom is then gradually thrust outboard until the sail is fully spread and only the inner end of the boom rests against the mast. This end simply rests against the mast and is not attached to it.

Vaka poti are rarely if ever used for inter-island voyages as most of the villages possess whale boats, which are more suitable for such trips. The natives, however, make fairly long coasting voyages in the *vaka poti*. They keep as close in shore as possible, rowing along the edge of the breakers in the narrow belt of comparatively calm water caused by the backwash from the cliffs. Even when there are large bays along the route they prefer to skirt the shore rather than to cut straight across. This custom of lying close inshore no doubt accounts in part for the indifferent way in which the boats are sailed. When the wind is astern the sheet is paid out on the side away from the outrigger, and as there is no way of reefing in case of a strong wind it is necessary for the occupants of the canoe to lean far out on the outrigger side or even climb out on the outrigger frame to keep the boat from capsizing. When the wind is on the port quarter the sheet is paid out on the outrigger side, but it is dangerous to sail this way as a sudden puff may drive the outrigger under and capsize the boat. When the wind is abeam the natives lower sail and row out against it for some distance, then spread sail and come in at a long slant with the wind on the quarter, repeating the maneuver whenever they get too close to the coast. They do not seem to understand tacking, and never sail except with a following wind.

ANCIENT CANOES

THE DUGOUT

Two ancient types of canoe are remembered by the natives, a small fishing canoe, and a built up war canoe. The small canoe is said to have been a simple dugout, identical with the modern fishing canoes already described except that it lacked the plank gunwales and had an outrigger of the ancient form (p. 309). Porter (49), who mentions these canoes, says that they were "commonly nothing more than the hollowed keels of the large ones after the upper works have been taken off." They appear to have been used only around the harbors, all longer voyages being made in canoes of the built up type.

BUILT UP CANOES

Large built up canoes have been obsolete for many years, as the Marquesans were quick to see the superiority of the European small craft and soon learned to imitate them. Even in 1838 Du Petit-Thouars (48, p. 348) says that the ancient canoes had been largely replaced by whale boats which the natives obtained from passing ships. Small built up canoes have, however, continued in use until comparatively recent times and a seaworthy example is still to be seen on the island of Fatu Hiva. The form of these smaller craft is well remembered by many living persons and from their descriptions, the numerous early

accounts and the fragmentary examples surviving in various parts of the group, it is possible accurately to reproduce the type.

Four species of wood were used for the large canoes *mio* (*Thespesia populnea*), *temanū* (*Calophyllum inophyllum*), breadfruit, and *hutu* (*Barringtonia speciosa*). The *hutu* was considered least desirable. *Mio* was rarely used, as large trees of this species were rare and the wood was in great demand for other purposes. Breadfruit wood was usually used for the smaller and poorer boats, while the best craft were made of *temanū*. Even at the present time there is some very large timber in the Marquesas (one *temanū* tree over ten feet in diameter was seen) but there is no native tree which produces a long straight stick at all comparable to the New Zealand *kauri*, and in very large canoes it was usually necessary to make the underbody in two or more sections which were dovetailed together.

Before the introduction of metal very large trees were felled with fire, but the shaping and hollowing appears to have been done entirely with tools. From a chant collected by Handy (personal communication) the tree appears to have been stripped of its bark and possibly of its branches before felling. The shaping was begun as soon as the tree was felled, the green wood being tougher and more easily worked. The tools used were stone adzes of various sorts, chisels and rubbing stones. (See chapter on Stone Artifacts.)

The building of large canoes was in the hands of *tuhuna* (skilled workmen) who merely supervised the work, leaving the actual labor to the friends and relatives of the owner. According to informants in Pua Ma'u, Hiva Oa, four hundred men (probably an exaggeration), under the direction of four *tuhuna*, were employed upon the last war canoe built there. The work was all done at the place where the tree had been felled, which in this case was high up the valley. Here a large decorated house was built for the workmen, who lived there with the directing *tuhuna* and were fed by the chief for whom the canoe was made. Twenty men are said to have been required to gather the food. The place was *tapu* to women and to all natives from other valleys. According to an informant from another valley some famous warrior slept in the unfinished canoe body every night in order that his *mana* might strengthen the wood and keep it from splitting. The completed canoe was carried down to the beach, probably in sections, and launched. [For an account of the ceremonies attending canoe building and launching see Handy (32)]. In Pua Ma'u the war canoes were kept assembled in special houses at the beach. These houses were undecorated and appear to have had no ceremonial significance beyond the fact that they were *tapu* to women. Each war canoe was named, a new canoe was given the name of a former one

which had been worn out or damaged. The names of the Pua Ma'u canoes were Vaimakamaka, the largest and most important, Vaioto, Taipehe and Meaupiau.

The canoe normally consisted of nine parts, the underbody, bow piece, stern piece, two side planks, and four strips used to cover the side seams. Certain other parts were occasionally added. Each of the large sections was usually hewn from a single piece of wood, while the strips were made of bamboo.

The underbody of one large canoe and part of a second underbody, which had been made in two pieces, were seen in the valley of Hakau, Nuku Hiva. The history of these objects had apparently been forgotten by the Hakau natives, but according to Atu Ona informants one of the underbodies belonged to a canoe called Mo'ote which was made in that valley by a *tuhuna* named Kaneautia. This canoe was sent to the chief of Hakau by a chief of Atu Ona in exchange for *enamo*, a yellow paint or dye used for anointing the body, prepared in Nuku Hiva by a secret process. The debris of a great *teman* tree from which this canoe is said to have been made is still to be seen in Atu Ona.

Hakau informants said that the two underbodies had belonged to separate craft, not to a single double canoe. On the other hand Christian (10, p. 180) mentions two old canoes in this valley which, from their location, seem to be the same as those here referred to and gives a photograph of a large double canoe, unquestionably Marquesan, which he implies belongs with the reference. In this photograph each of the canoes appears to be complete in itself while the attachment consists of three cross poles, easily removable. It seems probable, therefore, that these canoes were used both singly and together.

A study of the complete underbody—which had been exposed to the weather and was much rotted and warped—brought out the following particulars:

It was 40 feet, 6 inches in length, with a maximum central width of 4 feet, which tapered to 2 feet, 6 inches at the ends. The original depth could not be accurately determined. The two ends of this underbody were identical.

The section of an underbody was much better preserved, having been stored under an overhanging cliff which protected it from the weather. If the underbody of which this had formed a part was similar to the complete specimen it must have been over 60 feet in length. Some old canoe models, which appear to be very accurate, clearly show that the two ends of underbodies were not always the same, the forward end often being made much broader and deeper to facilitate the firm attachment of the bow piece. The extreme shallowness and narrowness of the outer end of the section proves that it was the stern, and if we assume that the whole underbody was of the broad bowed type it is possible that it was not more than 40 to 45 feet in length. The dimensions of the section were as follows: Length 34 feet, 11 inches; maximum width (at a point 4 feet from the inner end of the section) 3 feet, 4 inches; width at stern, 1 foot, 6 inches; maximum depth (outside) 1 foot, 9 inches; depth at tip of stern 4½ inches. The walls were 1½ inches thick at the upper edge, increasing gradually to 2¾ inches in the center of the bottom. The cavity of the underbody had, in cross section, the form of a rectangle with rounded corners. The middle of the canoe was flat bottomed, becoming gradually more rounded toward the stern.

The rim of the underbody was flat and straight throughout its length, except for the last six feet of the stern where the walls of the underbody were thickened to form a longitudinal ridge about two inches below the upper edge. (See Pl. XLII, *A*.) The lower part of this ridge curved smoothly into the contour of the bottom, while the upper part ran back in a flat bevel at an angle of about 40 degrees to the line of the outer edge of the flat rim. The bow and stern of all underbodies appear to have been finished in this way. The tip of the underbody was cut squarely across, and the outside was flat and vertical. The rim was somewhat broader here than along the sides and had, in the center of its interior surface, a broad, rounded point, left at the time of its excavation. This feature is shown in small canoe models, and both the bows and stern of underbodies were probably finished in this way. The projection corresponded to a similar projection on the under surface of the stern and bow pieces, and no doubt helped to strengthen and make rigid their juncture with the underbody.

The inner end of the canoe section observed at Hakau was especially interesting as it showed the method of finishing a joint. The bottom was cut squarely across, and had no holes for lashings. The sides were cut back for a distance of two feet, the lower edge of the cut sloping upward gradually until its perpendicular inner end was only eight inches high. The surfaces of the side cuts were beveled, running to a thin edge on the inside, and were pierced with triangular holes for lashings. (See Pl. XLII, *B*.)

A row of similar holes was pierced through either side of the underbody about an inch below the rim. There were no holes at the ends. The lashing holes were an inch and a half in width and approximately an inch in depth, the base of the triangle being upward, and were placed at intervals of five to six inches.

Along each side of the section there was a row of three small projections which had been left at the time the canoe was hollowed out. These projections were six inches wide and five and a half inches high, the upper edges were two inches below the rim of the underbody. They had been carved into the form of squat human figures with disproportionately large heads, but the details had been practically obliterated. The projections were arranged in pairs, facing each other; the interval between pairs was 9 feet, 11 inches. The natives could give no information as to their purpose, but it seems certain that they served as supports for thwarts or seats. The complete underbody had no projections of this sort and these projections do not appear in any of the models studied.

Both underbodies were made of *temanu* wood and had been carefully rubbed down inside and out, obliterating all tool marks and giving the surface a finish as smooth as that of an ordinary bowl.

THE BOW PIECE

So far as known no bow pieces of Marquesan built up canoes have survived but excellent descriptions which check up with the accounts of early voyagers and the old canoe models were obtained from informants.

In a canoe with a forty-foot underbody the bow piece would be about fourteen feet long. Its shape (difficult to describe) can be seen from the accompanying photograph of a section of an old and apparently very accurate canoe model (Pl. XLIII, *A*). For the sake of convenience in description the bow piece may be divided into three parts, the deck, the neck and the figure-head. The deck was the rearmost section, which was enclosed between the ends of the side planks and bounded in front by a transverse flange, the breakwater, which kept head seas from entering the canoe. The deck of the bow piece was of the same width as the underbody, with a flat upper surface and vertical sides. The under surface was deeply hollowed, the lower edges being of the same width as the sides of the underbody upon which they rested. Triangular lashing holes were pierced through the sides a short distance above the lower edge,

while two other holes, one on either side, were pierced through the angle formed by the top and sides about half-way between the breakwater and rear end of the deck. The upper lashing holes, which served for the attachment of the ends of the side planks, did not pierce the cavity of the bow piece.

The neck, or portion lying between the breakwater and the figurehead, was two to three times the length of the deck. Its upper surface was flat, and was the same width as the deck immediately in front of the breakwater, tapering gradually toward the forward end. Its lower surface was hollowed for about one-half its length, the outer end of the excavation being cut to leave a semicircular projection like that already mentioned in the description of the ends of canoe underbodies. Beyond the end of the excavation a heavy flange projected downward, its lower edge being flush with the bottom of the end of the underbody when the bow piece was in position. On the outer side this flange curved up smoothly to the base of the figurehead. The lower edges of the sides of the excavated portion fitted accurately to those of the underbody, and were pierced with lashing poles. Above the edge, however, the sides sloped inward, the flat upper surface of the neck projecting beyond them on either side in a longitudinal flange.

The angle which the neck formed with the body of the canoe seems to have varied considerably. In the specimen photographed the neck is practically parallel to the upper edge of the underbody, and the early accounts and pictures would seem to indicate that this was usual. According to informants, however, it curved upward sharply beyond the end of the underbody, and all the recent canoe models show this feature in more or less exaggerated form. In the double canoe shown by Christian (10, p. 180), the neck of the bow piece of one canoe is of the form already described and curves upward at only a slight angle, while the neck of the other canoe curves up much more abruptly. In the second specimen the upper surface of the neck does not project over the sides, but curves down into them smoothly, as in the normal stern pieces.

The form of the figurehead and its relation to the neck can best be described by comparing it to a long handled shovel laid back up, the neck corresponding to the handle and the figurehead to the blade. The base of the figurehead projected out sharply from the neck on either side, while the forward end was semicircular or was bluntly pointed. The upper surface was convex, the point of greatest thickness being at the middle of the rear end. It was carved into a single, large, flat face, chin forward. The convention was the usual one except that the broad mouth was crescent shaped, and the ears were represented by thin semicircular flanges which projected from either side of the head just beyond its juncture with the neck.

THE STERN PIECE

Two forms of stern piece were employed in the Marquesan built up canoe. The one shown in the accompanying picture (Pl. XLII, *E*) is apparently the commoner type. For the sake of convenience in description this form may be divided into three parts—the body, deck and tail.

The body of the stern piece was that part which rested upon the underbody of the canoe. It formed a third to a half of the total length of the stern piece, supporting the deck and tapering off into the tail at the rear. The lower surface of the body was deeply hollowed, while the outer sides curved inward gradually meeting in a distinct ridge along the median line of the upper surface. The lower edges were cut to conform accurately to the upper edges of the stern of the underbody, and were pierced with holes for lashings. The rear end of the body terminated in a heavy, downward projecting flange which rested against the stern of the underbody and was identical in form and arrangement with the corresponding flange on the bow piece.

The deck, although hewn in a single piece with the body, had the appearance of simply resting upon it, its sides and rear edge projecting beyond the sides of the body. Its upper

surface was flat and almost rectangular, curving up into a transverse flange at the rear. At the forward edge of the body there was a narrow vertical flange, extending from its lower edge to the deck, which served to make a close joint between the stern piece and the side planks. The edges of the deck were pierced with two vertical lashing holes which served for the attachment of the ends of the side planks. The inner end of the stern piece was sometimes considerably thicker than that of the bow piece, raising the level of the stern deck. When such was the case the height of the transverse flange at the rear end of the deck, really a stern breakwater, was less than that of the bow breakwater. The upper edges of the two breakwaters were always at the same level.

In the two oldest canoe models studied, a long oval projection with an almost circular depression in its upper surface extended from the center of the stern breakwater over the body. The only genuine stern piece seen did not show this feature and it is not found in the more recent canoe models. The purpose of the projection was not learned.

The stern piece narrowed rapidly to form the tail, a long flat projection, like a thick plank with the edge up, which rose from the body of the stern piece at an angle of twenty to thirty degrees. It might be either straight or slightly curved, and was pierced near the outer end and along its length with two or more holes, or slots, which served for the attachment of various ornaments.

The stern piece of one of the large canoes in Hakaui referred to (p. 303), is said to have been eighteen feet long and of the type just described.

In the second form of stern piece (Pl. XLII, C) the deck and body parts were of the same form, but the rear end fitted down closely upon the stern of the underbody, without overlapping or projecting beyond it. Informants insisted that all canoes had the high tail piece, but were uncertain how it was attached to this form of stern. Fleurieu (23, pp. 131 to 132) says: "The stern is made of two planks four inches high, placed on edge and rising in the form of an elongated and flattened S." Stewart, an unusually trustworthy observer says: "From the keel on each side a light round timber extended, curving gradually upward like the runners in the front of a sleigh, and terminating in a broad flattened blade, six to eight feet above the water." (59, p. 244.) It seems probable, therefore, that in stern pieces of the sort just described the tail was made in two pieces which were lashed one on either side of the canoe.

SIDE PLANKS

The side plank of a Marquesan built up canoe was a flat piece of wood of the same thickness as the rim of the underbody and a foot to a foot and a half in width (Pl. XLII, G).

The upper edge was hewn into a narrow gunwale, the inside of which was flush with the surface of the plank, while the outside projected as a narrow flange. The lower half to two-thirds of the plank was cut away at either end in a long curve, so that while the length of the upper edge was equal to the distance between the outer surfaces of the breakwaters when the bow and stern pieces were in position, the length of the lower edge was only slightly greater than the distance between the inner ends of the bow and stern pieces. At the points of contact of the side planks with the end pieces, the inner surface of the planks was cut away to insure a tight joint, the cutting being deepest at the lower edge and becoming gradually shallower toward the top. As a result of this, the upper part of the side plank was forced out somewhat when it was in position so that the whole plank formed a slight angle with the sides of the underbody.

A series of triangular lashing holes, corresponding to those of the underbody in size and position but with the base down, were pierced through the side planks a short distance above its lower edge. Additional holes for the outrigger lashings were made through the upper edge immediately below the gunwale. There were usually three of these, the two outer holes being placed a short distance within the points of contact of the side plank with the bow and

stern pieces, while the third was midway between them. Other lashing holes were pierced through the lower edges of the projecting ends of the side plank and served to attach it to the bow and stern pieces, while still others were made under the gunwale at either end to serve for the attachment of bow and stern platforms. Where a supplementary breakwater was used, holes for its attachment were pierced through the forward ends of the side planks near their outer edges.

THE STRIPS

Four strips were used to cover the seams between the underbody and the side planks, bow and stern pieces.

The strips were of unequal length, the two outside strips extending the full length of the underbody while the inside strips only covered the space between the inner ends of the bow and stern pieces. The upper edges of the inside strips were cut away for a short distance at either end so as to form a close joint with the lower corners of the bow and stern pieces. The strips were made either of soft wood or bamboo and were an inch to an inch and a half in width. When bamboo was used a stalk was split lengthwise and the divisions at the joints cut out. The wooden strips were rounded on the outside and hollowed longitudinally on the inner surface. On long canoes the strips were made in several sections, but there seems to have been no definite order in the arrangement of these. Although the edges of the strips were cut to fit the sides of the canoe as accurately as possible, their purpose appears to have been to protect the pad used between the underbody and the upper sections rather than to make the seam watertight.

OTHER CANOE PARTS

Other elements were sometimes incorporated into the built up canoes.

A supplementary breakwater was in common use (Pl. XLII, *F*), consisting of a thin plank, in the form of a broad flat crescent with stubby points, which was sometimes attached to the upper edge of the bow breakwater. The lower edge of this plank rested upon the top of the breakwater and was accurately fitted to it, while the sides projected beyond the sides of the bow piece. It was attached by lashings to the center of the breakwater and at the ends of the side planks.

A second feature, of greater ethnological interest, was the use of bulkheads. No information was obtained from the natives in regard to bulkheads, but they are shown in certain canoe models and are mentioned by Porter in his description of the Ua Huka canoes. He says: "Three pieces of thin plank, placed in the manner of partitions, divide the interior into four parts and perform the office of timbers to keep the vessel from separating or closing." (49, p. 79.) Judging from the models, these planks were cut to fit accurately the interior of the canoe, being notched on either side to accommodate the strip covering the side seam. The tops were flush with gunwales to which, in one model, they were fastened by single lashings near the top on either side.

It is probable that thwarts designed simply to strengthen the canoe were not used, but the war canoes had seats for paddlers. According to informants the seats were flat planks resting upon the top of the inside strips. Large canoes might have as many as ten seats.

ASSEMBLING THE CANOE

In some of the larger valleys the canoes were kept in special houses on the beach, and were probably left assembled at all times. According to informants in other places, canoes were usually taken to pieces as soon as they were beached and the parts carried up into the valley. A highly probable explanation of this

practise, which involved much unnecessary labor, is given by Porter (49, pp. 101-102). He says:

Each piece, and indeed each paddle has its separate proprietor. To one belongs the piece projecting from the stern, to another the part forming the bow. The pieces forming the sides belong to different persons and when a canoe is taken to pieces, the whole is scattered throughout the valley and divided, perhaps, among twenty families. Each has the right of disposing of the part belonging to him, and when it is to be set up each brings his piece with materials for securing it. The setting up of a war canoe goes on with the same order and regularity as all their other operations.

Mention of this curious system of ownership is also made by Desgraz (15, pp. 281-282) but as his book appears to be a little more than a compilation from earlier sources, this can hardly be taken as a verification.

It seems certain that there must have been a definite order in which the various sections were placed in position, but no exact information was obtained on this point. The structure of the canoes, however, partially indicates the following sequence:

The first step must have been to arrange the pads which took the place of caulking between structures or sections. There were four of these, two being placed along the sides of the underbody and one at either end. The side pads consisted of two thick flat ropes, of the same length as the underbody, each of which was plaited from three strands of coconut husk fiber. Cellular tissue of the husk was left adhering to this fiber, probably with the idea of filling the interstices and making the finished seam more nearly water tight. These ropes were laid along either edge of the underbody, being held in position by continuous bark strings which fastened them to the underbody at each lashing hole. The end pads were made from a number of the fibrous leaf sheaths of the coconut which were spread out flat with their upper ends resting on the top of the underbody and their lower ends bending down over its flat vertical bow and stern. They do not seem to have been attached to the underbody in any way.

The next step was to place the bow and stern pieces in position, and then the side planks. Whether the bow and stern pieces were attached before the side planks were put on is uncertain, but it seems probable that the whole superstructure was lashed to the underbody in a single continuous operation. In the models the lashing of each side is done with a single continuous line, beginning at the bow.

The lashings were of broad three-plait coconut fiber cord considerably heavier than that used for house lashings. This was passed several times through the upper and lower lashing holes, outside of the strips, the outer side of the lashing being flat, the full width of the hole, and only one cord thick. According to one informant a large wooden needle, with the point barbed on one side was used to facilitate passing the cord in and out. (See section on Miscellaneous Tools.) The upper ends of the side planks were attached to the bow and stern pieces by small lashings, each of a single piece of cord tied on the inside. The inside lashings are said to have been ornamented on some canoes with designs derived from string figures.

CAULKING

The lashings of the underbody and superstructure did not completely fill the triangular holes provided for them, and the openings were caulked with pieces of coconut husk wadded up and beaten in with a wooden mallet and pointed stick. (See section on Miscellaneous Tools.) The seams at the ends of the canoe were calked

with feathers, beaten in. Langsdorff (38, p. 173) says that the seams were covered with the gum of the breadfruit tree, but this was not mentioned by informants or by any other early visitor. All accounts agree that the craft leaked so badly that one or two men were kept constantly employed bailing.

THE OUTRIGGER

All canoes, when not fastened together in pairs, were provided with outriggers. Quiros (50, p. 28) says that they had "outriggers of cane on either side, after the manner of the gunwales of galleys." Porter (49, p. 102) also mentions the use of double outriggers in connection with large canoes differing somewhat from the type now under discussion. Canoes appear, however, to have been normally fitted with a single outrigger on the right side.

This outrigger was of indirect type, consisting of crosspieces, uprights and a float. In the smaller craft two crosspieces only were used, in the larger canoes there were three, the third being in the middle. These crosspieces passed over the canoe, their right ends projecting beyond it, and were lashed firmly to the side planks by cords passed through holes in the upper edges of the side planks.

Each of the uprights consisted of four or six small sticks or splints. When four sticks were used they were placed two on either side of the crosspiece, and the lower ends of each pair rested together, the upper ends being some inches apart so that they formed a V. Each of these V's in turn sloped outward from the crosspieces; their attachments to the float were a foot or more apart. Informants say that this form of upright, although much more difficult to make than the modern one, was superior to it. In landing through a heavy surf the forward end of the float often strikes bottom, and with the modern heavy upright the canoe is turned end over end. When the old upright was used the thin sticks of which it was composed broke easily, and the canoe would land without capsizing. The lower ends of the uprights were wedged into slots in the upper surface of the float, which consisted of a hibiscus log sharpened at the forward end.

CANOE PLATFORMS

According to old accounts the large war canoes were provided with platforms at bow and stern, while Porter (49, p. 101) mentions an additional central platform on which the chief sat. The use of such platforms is only vaguely remembered by the natives and these platforms are not shown in the newer models. Stewart (59, p. 244) says that the platform was made of small sticks and covered with a mat, and that the stern platform was considerably higher than the one in the bow. In two old models the stern platforms are made as follows:

Two rather large peeled sticks were laid across the canoe, the inner stick being close behind the forward end of the stern piece while the outer was just in front of the breakwater. Two other poles were then laid across the ends of these, lengthwise of the canoe, and the whole lashed to the side planks with bark rope passed through holes in the canoe. The rear ends of the second pair of poles projected slightly beyond the stern breakwater. Two more cross poles were laid on the ends of these, above which two very long poles were placed lengthwise, their tips projecting back almost to the tip of the upward curving tail. The four upper poles were then lashed to the frame formed by the four lower ones. The bow platform was built on the same principle except that the tops of the second set of poles were flush with

those of the supplementary breakwater, and two long poles like those of the stern platform were lashed to these, one on each side. The tips of these poles projected forward almost to the figure head. In rear platforms the top of the cribwork was probably floored in some way. The platform was quite small, and according to the early accounts, was occupied by only one man.

DECORATION OF CANOES

Canoe decorations fall at once into two classes—carvings and decorations incorporated into the canoe and temporary decorations. The use of ornamental lashings has been mentioned, but no details are available.

All informants agree that the bow and stern pieces, and less commonly the side planks, of large canoes were carved. The figurehead, at the forward end of the bow piece, consisted of single large flat tiki face but the designs used on the other parts of the canoe are said to have been either angular-geometric, like those used on house posts, or curvilinear like those used in tattooing. The bow and stern pieces of most canoe models are decorated with angular-geometric designs and these appear to have been more commonly employed on the actual canoes. There was a tendency also to decorate the neck of the bow piece with figures carved in high relief or by the attachment of separate pieces. One old canoe model (Pl. XLIII, *A*) has, down the center of the bow, two recumbent figures placed face up, with their feet together and their heads touching the front of the breakwater and the back of the figure head. They are carved in one piece with the bow, but are in almost full round, the only points of attachment being the tops of their heads and their buttocks. The bow piece of a second old model has down the center of the top a flat longitudinal ridge to which is lashed a thin vertical plank pierced with two large holes. The rear edge and bottom of this plank form a right angle and the forward edge is curved. In the picture of a Marquesan canoe given by Cook (14, p. 307) the bow has along its center three projections, evidently thin planks two or three feet long, which are recurved at the upper end, like pruning hooks, and have on the back two points. In front of these points large triangular holes are pierced through the plank. Porter (49, p. 79) says that some canoes of Ua Huka had on the bow a small board supported by a rudely carved figure of a man. The more recent models show no trace of these neck decorations. They seem to have been replaced by temporary decorations at an early time.

A small tiki figure was attached to the tip of some of the stern pieces. Stewart (59, p. 244) says that between the two sticks forming the tail of the canoe "a rude image of a god was suspended in a reclining posture." This is verified by a canoe model which has attached to the tip of the stern piece two broad wooden blades which project backward, diverging slightly. Between these blades there is a small tiki figure, facing the canoe in a nearly horizontal position. In Pua Ma'u a small full figure tiki was carved on the top of the tail piece.

The longitudinal strips covering the outside seams of the canoe were painted black and ornamented at each lashing by tufts of white feathers of the *tevake* bird. The feathers were placed on the stern side of each lashing, and were held in place by the two or three rearmost loops, their inner ends resting directly upon the strip.

The temporary decorations in most general use consisted of coconut fronds which were placed along the sides of the bow and stern platforms with their lower edges trailing in the water. According to one informant they were also placed along the sides of the canoe, but no mention of this is made by early writers. Stewart (59, p. 244) says that in the large canoe seen by him "between the figure head and the bow, three green coconut leaves, four or five feet high, were fastened erectly." Porter (49, p. 102) says: "The seat of the coxswain is highly ornamented with palm leaves and white cloth."

Porter (op. cit.) says that the bow was ornamented with pearl shells strung on coconut branches.

Two cords were run from the rear corners of the stern platform to the tip of the stern piece, these cords being decorated with tufts of human hair and *pavahina* (ornaments made from white beards). These cords are still present in one of the old models, attached to the ends of long poles projecting from the stern platform. It seems probable that long tapa streamers were also attached to the stern piece, as several of the models are decorated in this way.

Stewart (59, p. 327) says: "A skull was lashed on each corner of the platform elevated at the stern." According to an old informant, the bodies of any enemies killed during a raid were laid across the neck of the bow piece during the homeward voyage.

HANDLING OF THE CANOES

According to informants the large war canoes were never sailed, but small canoes and double canoes, made from two craft of this type lashed together, were sometimes sailed. The paddlers sat two on a seat and paddled rhythmically, usually chanting in time to the strokes. The steersman sat on the raised stern platform, using a long paddle of ordinary Marquesan form. According to one informant there were two steersmen, one on either side. Porter (49, p. 102) says of these craft: "They are not so fleet as might be expected, as our whale boats could beat them with great ease," and all the early accounts agree that they were rather poorly handled.

SPECIAL TYPES OF CANOES

Mention has been made of double canoes, but according to all the information obtained by the author these were simply canoes of the built up type which

were temporarily fastened in pairs. They were fastened together by heavy poles, corresponding in position to the crosspieces of the outrigger. The space between the canoes was covered with a temporary platform. In some stories mention is made of a railing around this platform. (Handy, personal correspondence.) Double canoes of this sort were used for inter-island trips and for long fishing trips, when the crew expected to be away for several days. Double canoes, made from fishing canoes, are said to have accompanied the war canoes on long raids to carry supplies.

Porter (49, pp. 102-103) mentions still another type of craft which is so remarkable that it seems best to give the quotation in full. He says:

Their fishing canoes are vessels of a larger and fuller construction, many of them being six feet in width and of an equal depth. They are managed with paddles more resembling an oar, and are, in some measure, used as such, but in a perpendicular position, the fulcrum resting on the outriggers projecting from each side. With these they proceed to the small bays on the coast, where they fish with the scoop net and with the hook and line. . . . The canoes used for the purpose of navigating from one island to another, a navigation very common, are similar in their construction to the larger kind of fishing canoes, and are secured two together by beams lashed across. These are called double canoes and are furnished with a triangular sail made of mat. . . . These are also worked during a calm with paddles and appear capable of resisting the sea for a long time. The canoes formed for the sole purpose of going in search of new lands are of a still larger construction, and are rigged in the same manner.

No other author mentions craft of this large type but the quotation just given is preceded by a detailed and accurate account of the built up canoes and, except for a tendency to exaggerate dimensions, Porter's accounts of material culture seem to be thoroughly trustworthy. It seems certain that at the time of his visit the Marquesans had some vessel of much larger size than the built up canoe and differing from it in construction.

Informants made no mention of craft of this sort, and the type probably became extinct at an early time. Even at the time of Porter's visit the natives had had considerable contact with Europeans, and there were white sailors settled among them. They are, as a race, quick to see the advantages of mechanical improvements, and the rapid adoption of the present type of outrigger shows the speed with which a new idea may spread among them. They had undoubtedly seen many ships' boats, and it is quite possible that they had already developed a hybrid form intended to embody the advantages of both ships' boat and canoe. We have seen that in 1838, twenty-five years after Porter's visit, whale boats had supplanted most of the large canoes, so that the life of the new type would have been short.

On the other hand, Porter specifically says that the large double canoes were of this type, a strong evidence that it was pre-European. Moreover, his

brief description of the manner of propulsion applies perfectly to the Tongan method of sculling large craft. It would be practically impossible to build a boat six feet wide and of the same depth on the lines of the built up canoes already described, and it seems certain that these boats were made either of planks or of many pieces. Plank canoes were used in the Society and Tuamotu groups and the Marquesans could hardly have been ignorant of this form of boat.

In a legend of the migration of one of the tribes of Hiva Oa, which was driven out by its neighbors and went to seek new land, it is stated that they departed on large bamboo rafts. The tribe in question lived on the plateau and were said to have used these craft because they had no wood suitable for canoes. No details as to the construction could be obtained.

Porter (49, p. 103) says:

"[The natives] use also occasionally a kind of catamaran, which they construct in a few minutes, and a kind of surf board. . . . These, however, scarcely deserve to be enumerated among their vessels, as they are used chiefly by the boys and girls, and are intended solely for paddling about the harbor."

SAILS

The aboriginal type of sail became obsolete at an early date and it is doubtful whether any of the living natives have seen a genuine ancient sail. Informants insisted that they were like those in use at the present time except that the boom sloped upward instead of being horizontal and that the sail itself was made of coconut mats instead of canvas (pandanus mats were tapu for sails). This agrees perfectly with the brief mention of Porter and the picture given by Cook. Porter (49, pp. 102-103) says:

Double canoes . . . are furnished with a triangular sail made of mat, similar to that called a shoulder-of-mutton sail but placed in an inverted position, the hypotenuse forming the foot of the sail, to which is secured a boom.

The drawing published by Cook (14, p. 307) shows a single canoe provided with a mast of rough timber and a triangular sail of matting along the lower edge of which there is a boom also of rough timber. The boom is set at an angle of about forty-five degrees, the apex of the triangular sail being at the juncture of the boom and mast. The upper edge of the sail is concave, and the tips of the mast and boom project for some distance beyond the fabric of the sail. The mast is stayed by a rope running from a little below the masthead to the center of the bow projection, and by three other ropes two of which run to the stern outrigger crosspiece a short distance outside the gunwales of the canoe, while the third is attached to the crosspiece near its outer tip. In the picture the sail is directly over the canoe, between the two inner stays, a system impossible in practice. It seems probable that the author placed it in this position in order to better show

the arrangement of the stays. A slack line is shown running from the outer end of the boom to the stern seat to control the sheet. In the drawing the lower end of the boom is concealed, but it seems probable that, as in the modern sail, it was not attached to the mast. In the background of the picture there are two small distant canoes one of which is shown under way with the sheet paid out. The side stays are fastened to the bow instead of to the stern outrigger crosspiece, while the bow stay is replaced by a single stern stay. The second canoe is shown with the sail furled, apparently by bringing the boom up against the mast. The method of stepping the masts of the ancient canoes was not ascertained. According to information obtained by Handy, a square rail was used, with a spar at the top and bottom.

PADDLES

Porter's mention of "paddles more resembling an oar" (49, p. 152) would imply that more than one type of paddle was in use in the Marquesas, but all the specimens seen or described by informants belong to a single well defined type.

The paddles were made of rose wood, and were often decorated with carving. The manufacture of small highly ornamented paddles of somewhat degenerate form intended for sale as curios has continued until the present time, but the natives have lost the skill necessary for the manufacture of the large genuine specimens; the only ones seen in actual use were old.

The peculiar shape of Marquesan paddles makes them easily recognizable in any collection. (See Pl. XLIII, *B*.) In length they range from 4 feet, 8 inches to 5 feet, 8 inches, although the steering paddles used on war canoes were probably still longer. The average length is slightly over 5 feet. For convenience in description they may be divided into three parts, the shaft, the blade, and the terminal knob, a projection below the blade.

The shaft is approximately circular in cross section and tapers very slightly toward the upper and lower ends. In some old specimens the central part is somewhat flattened laterally, but this may be due to long use. The upper end terminates in a cylindrical knob, slightly thicker than the shaft, or in a flat expanded transverse grip with a concave upper surface. Only one specimen of this sort was seen, the grip in this having been originally two inches in width. At the lower end the shaft passes imperceptibly into the blade.

The total length of the blade, exclusive of the terminal knob, is one foot to 15 inches, with a maximum width of 6 to 7 inches. The wings of the blade curve outward gradually from the shaft to the point of maximum width, which in a blade one foot long is slightly less than 11 inches from the upper end. From this point they curve inward sharply toward the base of the terminal knob. The thickness of the wings at the edges is about $\frac{1}{4}$ inch, this thickness remaining uniform for the entire length of the blade. The center of the blade has a thickness of $\frac{1}{4}$ to $\frac{1}{2}$ inch, gradually increasing toward the ends. The outer surface of the blade is convex, either smoothly rounded or with a slight longitudinal ridge along the center. The inner surface is concave, the center, at the point of greatest depth, being sometimes as much as $\frac{1}{2}$ inch below the level of the wing edges.

The form of the terminal knob may be seen from Plate XLIII, *B*. The knob is connected with the blade by a short neck which curves upward and backward. The inner side of this neck bears a rather sharp longitudinal ridge which continues for a short distance up the blade. The outer surface is flat or bears a much lower longitudinal ridge which continues for a short

distance up the blade. The two surfaces meet in a rounded edge into which the wings of the blade blend gradually. The knob proper is set at an angle with the neck, causing it to project slightly backward from the line of the blade. It is sharpened anteriorly and posteriorly except at the rear end of the outer surface, where it is sometimes flat. The knob thickens gradually from the neck to a point about two-thirds of its length from the base, then thins gradually to the tip, which is finished with a blunt edge.

This knob is the most characteristic feature of Marquesan paddles and its uniformity in shape and proportion in different specimens seems to indicate that it served some definite purpose. A number of explanations were given by the natives, the usual one being that it caused the paddle to make a pleasant sound when pushed through the water. Other explanations are: That the knob made the paddle a more effective club in sea fights; that it prevented the blade from being splintered when pushing off the rocks; that by means of it the paddle could be rested securely on the forked top of the outrigger; and that it kept the blade from side slipping in the water. The knob does fulfill all these purposes. A somewhat similar knob appears on paddles from Easter Island and Mangareva.

The manufacture of paddles of this sort called for a carefully preconceived design and great skill in execution. The finished instrument justifies the care expended upon it, however, for in balance and effectiveness these curiously shaped paddles are greatly superior to the European forms.

DECORATION OF PADDLES

In pre-European times paddles were decorated with carving applied to the knob at the upper end of the shaft, the blade, and possibly the terminal knob. Carved paddles are still manufactured in the Marquesas for sale to Europeans, and practically all specimens now in museums belong to this class. No authentic ancient specimen was seen, and it is impossible to tell whether the designs employed in the modern paddles are the same as those used in ancient times.

Two distinct techniques were employed. In paddles made of *mio* wood the designs were simply carved upon the surface. In paddles made of *hutu* wood (*Barringtonia speciosa*) on the other hand, the surface was first charred to blacken it, and the designs were then cut through the blackened wood to the natural white wood underneath, making the finished design show in sharply contrasted black and white. *Hutu* wood was rarely used for real paddles, and it seems doubtful whether this second technique was applied to paddle decoration in ancient times.

The knob at the upper end of the paddle shaft was carved either into two small tiki figures, placed back to back, or into two heads similarly arranged. The convention of representation was the usual one, flat features, spectacle eyes, and broad mouth. In some paddles the space between the figures was pierced.

The paddle blades were elaborately carved on both the upper and lower surfaces, and in one specimen the decoration extended a short distance up the shaft. The area to be decorated was divided transversely into three or more zones which were treated as separate units. The lowest of these zones was semicircular, the outer edge corresponding to the bottom of the paddle blade. There was a strong tendency to make a large semicircular figure the principle feature of

at least one other zone. In all the specimens seen there was a complete absence of simple angular-geometric designs of the house post type. The designs used were selected about equally from those regularly used for tattooing and bowl carving. Tiki faces and even flattened figures were noticed in a few paddles. Edge-Partington (20, p. 5) shows a paddle having a design carved on the inner side of the blade and two heads in high relief on the outer side.

It would appear that paddle designs did not constitute a distinct class. All the specimens studied are more or less recent, however, and it is quite possible that there were originally distinctive paddle designs which have been gradually overlaid or lost. In many of the commercial specimens the terminal knob is decorated with very simple angular-geometric figures like those carved on house posts, but it is impossible to say whether the practice is ancient.

BAILERS

The constant leaking of a built up canoe made the bailer a necessary part of its equipment, and bailers of the ancient form are still in constant use throughout the group. These bailers are made of *mio* or *temanu* wood, and are shaped like a sugar scoop with the handle reversed, that is, projecting forward over the cavity. The top of the bailer is perfectly flat, the upper side of the handle being flush with the edges of the scoop. The bottom is also flat, rounding up gradually in the rear. The forward edge of the scoop is straight, the upper corners being rounded off. In ancient times some bailers were carved, but no decorated examples were seen. (See Pl. XLIII, *D* and *E*.)

CANOE MODELS

Numerous references have been made in the course of this paper to canoe models. At the present time many of these models are made for sale to Europeans. The industry centers in Fatu Hiva. It is certain that models were also made in early times, and there is mention of their use in connection with religious ceremonies. The modern models are elaborately carved all over; the designs used are borrowed from tattooing and bowl carving. (See Pl. XLIV, *B*.) The designs used upon the superstructure are usually simple angular-geometric motifs of the sort said to have been used upon the actual canoes, although in the recent specimens there is a tendency to apply curvilinear designs to these parts also, especially to the side planks. Many of the recent examples are made of *hutu* wood, treated by the method mentioned in connection with the paddles.

The desire for quantity production has led in the newer models to a lack of accuracy in the proportions of the various parts and the omission of all details not visible when the canoe is assembled. They can therefore serve as a guide only to the general form of the ancient craft. The really old models

on the other hand are decorated only on those parts which were decorated in the actual ancient canoe and show a close attention to all details, even those hidden when the canoe was assembled, which is good evidence that the maker attempted a replica of the actual craft. At the present time the natives make models of the European vessels which visit the group and these models are properly proportioned and surprisingly accurate as to detail, the original of any model being at once recognizable. It seems probable, therefore, that the old models reproduce the real canoes with similar exactness, and it seems justifiable to use them for illustration and for the settlement of doubtful points.

Probably the earliest model now preserved is that in the Peabody Museum of Salem, Mass., which was made before 1820. (See Pl. XLIV, *A*.) As may be seen from the photograph it differs somewhat from the descriptions obtained. There are no separate bow and stern piece, the figurehead rests directly on the top of the cutwater, and the outrigger is unusual in form with a direct attachment. It is possible that it reproduces a special type, now forgotten, but it is equally possible that its extremely small size has led to the omission of certain features. Next in age to this model are two preserved in the Bishop Museum (Pl. XLIV, *C*) which agree in every way with the descriptions given, and appear to be accurate replicas of the ancient craft. The highly decorated example (Pl. XLIV, *B*) is comparatively new, and was probably made for sale to Europeans.

COMPARISON OF POLYNESIAN CANOES

The simple dugout is of such widespread use among primitive peoples that a consideration of its occurrence is of little or no comparative value. Quite the reverse is true, however, of the built up canoe, as such craft offer a wide field for possible variation. If we study the Polynesian canoes of this sort we find that in Tonga and Samoa, and from there eastward to the Society Islands, these craft were built up of many sections, each cut to fit its position in the whole. These sections were fastened together by cords passed not through the body of the plank; but through oblique holes cut in flanges or projections left on the inner side of each section at the time it was hewn. No lashings were visible on the outer surface, which, after the boat was assembled, was rubbed down to an even finish. The sections were so accurately fitted that it was often difficult to detect the joints. In Hawaii, the Marquesas, and New Zealand, the built up canoe consisted of five parts, an underbody—hewn when possible from a single log—bow and stern pieces, and side planks. These were attached by lashings passed through holes in the body of the plank so that they were exposed on the outside. The Samoan and Tongan craft had a sharp cutwater and were flat at bow and stern. Certain parts of the larger Samoan canoes were carved but the bow and stern decorations were limited to knobs carved on the flat upper surface or on the

edges of the gunwales. Only one Samoan form, said to be a result of foreign influence, had an upward curved projection at bow and stern. In the Hawaiian canoes we find no distinct cutwater as the bottom curves upward and narrows to a point. The bow is unornamented but has a short projection. In the Marquesas and New Zealand the bow and stern of the underbody are of the form just described for Hawaii. The bow piece extends for some distance beyond the end of the underbody while the stern piece curves upward to form a high tail. In the Society Islands the canoes were built of many pieces. The entire hull curved upward at the stern rising almost vertically for some distance, and was crowned with carved figures. At the bow there was a second projection which on some was decorated.

The sails used in Hawaii, the Marquesas, and New Zealand were made in the form of a triangle, with the apex at the foot of the mast and the boom along the lower edge. In Tonga and Samoa, on the other hand, the sail was supported by a yard, or yards, hung from the masthead. The Society Islands sail was fundamentally of the first mentioned type, but differed in having the upper end of the boom recurved.

Bailers appear to have been much the same everywhere in Polynesia, but were decorated with carving only in New Zealand and the Marquesas. Marquesan paddles appear to have no exact oceanic parallels, but resemble somewhat those from Easter Island and Mangareva. It is interesting to note in this connection that many of the Hawaiian paddles have on either side, near the tip of the blade, a short rib which serves no practical purpose. It seems possible that this is a survival of an earlier knob or end projection.

It is apparent that in the canoes, as in the houses, there are clear indications of an eastern and a western type. The eastern type is characterized by the use of only five essential parts, bound together by lashings which are visible externally, and by the use of a triangular sail and boom. The western is characterized by the use of many parts bound together by lashings, invisible externally, and by the use of a sail with a movable yard hung from the masthead. The use of ornate bow and stern pieces is unknown in the western area, with a single possible exception, but is normal in the eastern area except Hawaii.

If we compare the Maori and Marquesan canoes we find a series of resemblances so striking that they argue a close cultural relationship. Both boats are basically the same in the form and arrangement of the parts, and in both the bow piece terminates in a figurehead. In the smaller Maori canoes this figurehead is a simple face borne on the end of a constricted neck, as in the Marquesan form. In the more elaborate Maori forms the figurehead is carved into a full figure, but the high vertical ornament of the Maori bow pieces finds a parallel

in the pierced planks placed along the center of the Marquesan bow piece. In both we have the high ornamental stern projection. In both, the upper edges of the side planks were expanded to form flat gunwales and the planks themselves were often decorated with carving. In both the Maori and Marquesan canoes, the strips covering the outside of the seams between underbody and side plank were blackened and were decorated with tufts of white feathers at the lashings. Among the Maori, the feathers for this seam decoration were obtained from the shearwater, and although the species of bird from which the Marquesans obtained their feathers for this purpose was not identified, the native descriptions of the habits of the birds makes it almost certain that these people also obtained their decorations from the shearwater.

The resemblances just noted are too close and numerous to be the result of independent evolution, and although the canoes of the two groups differed in certain minor structural details, the conclusion is inevitable that they represent divergent developments of a single type. The existence of such closely related forms at almost opposite ends of the Polynesian crescent, when the space between is occupied by forms which differ from both more widely than the Maori and Marquesan canoes differ from each other, is best explained by the assumption that they represent marginal survivals of a form which had been diffused over the whole eastern area, but which has been destroyed or overlaid in the intervening regions. The Society Island canoes, with their combination of high stern and prow with many piece construction, are probably a hybrid type resulting from the superposition of the western style of construction upon the Maori-Marquesan form. The exact relation of the Hawaiian canoe to this Maori-Marquesan form is difficult to establish. Basically they are the same, but the Hawaiian canoe lacks all the ornamental features of the other type. It seems probable that both are descended from a common ancestor while the relatively greater simplicity of the Hawaiian canoe suggests that it stands nearer to this original form. The features which distinguish the Maori-Marquesan type—the high bow and stern and profuse decoration—are strongly suggestive of Melanesia, and it seems probable that they are a result of Melanesian influence.

STONE ARTIFACTS

The original settlers of the Marquesas must have been in possession of effective wood working tools, as they would otherwise have been unable to make the large seagoing craft necessary for so long a voyage. There is nothing to indicate that they were familiar with metals, and these tools must therefore have been of stone or shell. In Oceania the use of shell adzes is practically limited to localities in which stone is rare or absent and it seems probable that the first arrivals in the Marquesas brought with them a knowledge of stone working and of at least the simpler implement forms. The islands of the group, with a single unimportant exception, are volcanic, having a great variety of lavas, basalts and tuffas, but they contain no workable deposits of sedimentary or metamorphic rocks. The presence of obsidian is questionable. The primitive implement maker thus had an abundance of material at hand which could be worked by the processes of pecking, grinding and chipping but no minerals which could be pressure flaked. Deposits of workable stone occur in practically all the large valleys, and although there was a distinct tendency toward local specialization and trade, implements of all the known types appear to have been at least occasionally manufactured in each locality. The stone working industry was thus in the hands of many persons, with a corresponding increase in the chances of individual variation. There are a few indications of the existence of local implement types, but the differences are unimportant.

HAMMERSTONES

The hammerstone is the foundation of any stone industry. Marquesan hammerstones were simply hard, water worn pebbles of convenient size and form which were obtained from stream beds or boulder beaches. They were not shaped and appear never to have been hafted, and can be distinguished from other pebbles only by the battering of the ends. (See Pl. XLVIII, *F.*)

ADZES AND CHISELS

Under this head it has been thought best to describe all stone implements other than gouges, which have a cutting edge transverse to their long axis. No axes have been reported from the Marquesas. Many implements may, from their form, be at once identified as true adzes, but there is a large class of tangless blades whose use can not be established by the form and it seems best to describe them as a group rather than to risk the error of an arbitrary division into adzes and chisels.

Adzes and chisels appear to be uniformly made of phonolite. The material varies more or less, especially in the larger specimens, and it is evident that it was obtained from several sources. No adz quarries were visited, and from the ac-

counts of informants it appears probable that the stone was obtained from rock slides and boulders in the river beds. According to information obtained by Handy in Pua Ma'u, Hiva Oa, a boy's first adz was made from a fragment of a special black stone which was kept for that purpose in the *me'ae*. Informants were ignorant of the original source of these stones, and of how they were replaced when used up. No objects which might answer this description were seen in any of the *me'ae* visited.

The only large adz workshops visited were on the island of Ei Ao. During the late prehistoric period this island was a tributary of one of the tribes of Nuku Hiva, and the adzes made there were brought to Nuku Hiva and from there distributed in trade to all the other islands of the group. The area of these workshops, and the quantity of chips and rejects, would indicate a highly developed, long continued industry. No regular quarries were known to natives familiar with the island, but a few boulders of phonolite suitable for adz making were seen. Small workshops are scattered all over the island, but curiously enough the center of the industry appears to have been on the top of a high ridge running along the southern side of the island, at a considerable distance from any source of material. Two striking features of the workshops of Ei Ao are the preponderance among the rejects of small thin forms, and the lack of ground specimens and grinding stones. This would seem to indicate that the trade called for chisels and carving tools rather than for large adzes and that the blades were exported unground.

The only tools employed in adz manufacture were hammerstones and grinding stones. The grinding stones consisted of smooth surfaced natural rocks of varying grain upon which the adzes were rubbed. Large natural boulders whose surfaces have been worn into pits and grooves by adz grinding are still visible in the neighborhood of many settlements. The grinding of the gouges must have been done with some sort of small whetstone, but no examples were seen. Chants collected by Handy (personal correspondence) mention the use of sand in either the grinding or finishing of adzes, and it seems probable that the sand was placed in the grooves and hollows already worn in the large grinding rocks to hasten the abrasion.

The processes employed in adz manufacture were chipping and grinding, with a limited use of pecking. This last appears to have been used only in connection with a single specialized adz type, the *toki aa*. It is evident from rejects that the adz makers were especially skillful in chipping, bringing the implement to approximately its final form by this method. The chipping upon the bits of adzes is especially fine, the work approaching in excellence that done elsewhere by the pressure flaking process. The cutting edge of the adz was always ground

but the finish on other parts of the implement was extremely variable, used specimens showing all conditions from simple chipping to complete grinding and high polish. According to one of the chants already mentioned the finished adz was honed on the thigh to produce a final polish. The making of a boy's first adz was accompanied by various religious observances which have been described by Handy (32).

The collections of the Bishop Museum contain nearly fifty Marquesan adzes and chisels, and an approximately equal number have been studied elsewhere. From this series it is evident that in the Marquesas these artifacts show a higher degree of variation than in any other part of Polynesia with the possible exception of New Zealand. As a whole they fall at once into two main groups, distinguished by the presence or absence of a tang, while the tanged adzes may be further divided into simple adzes, *toki aa* and *toki kouma*.

SIMPLE TANGED ADZES

The blades of the simple tanged adz are distinguished by a broad straight bit, a cross section varying from rectangular to triangular and sides which slope inward toward the poll. In the quadrangular examples the inner surface may be either flat or slightly concave. The tang is formed by chipping away a portion of the upper end of the outer surface. It can not be distinguished on the inner surface. In some of the triangular specimens the sides of the tang are also chipped away, giving the blade a slight shoulder, but this is not a common feature. As a rule these blades are ground only on the bit and outer surface, exclusive of the tang. In all the quadrangular examples the width of the inner surface is equal to or less than that of the outer surface, never greater. Many of the rectangular specimens of this type agree so closely in form and finish with the normal adzes of the Hawaiian group that in a mixed collection it would be impossible to distinguish them. (See Pl. XLV, *D*.) The triangular adzes of this type, on the other hand, are practically identical with those normal for the Society Islands. (See Pl. XLV, *A-C*.) The bulk of the specimens fall between these two extremes.

TOKI AA

Blades of the *toki aa* type are recognized as a separate class by the natives themselves. They are characterized by a distinct tang, a heavy blade of rectangular cross section, and a more or less complete grinding of all the surfaces. Practically all the specimens of this class are large. The most striking features of the type are the great thickness of the blade portion, which in many adzes exceeds the width of the cutting edge, and the high angle formed by the two faces of the bit, usually fifty degrees or more. The *toki aa* appear to have been the only adzes in whose manufacture the pecking process was employed. In one of the Bishop

Museum specimens, No. B3070, the tang has evidently been shaped by this method, while an unfinished specimen, No. B3074, is pecked at the bit. *Toki aa* are said by the natives to have been used for the final dressing of planks. (See Pl. XLV, E, F.)

TOKI KOUMA

The *toki kouma* are also recognized by the natives as a distinct class. They are characterized by a long narrow blade of triangular cross section, a well marked tang whose outer surface is often concave, and a narrow bit. In many examples the whole implement has a slight backward curve, the inner surface, which forms the base of the triangle, is more or less concave. The bit is formed by grinding away the base and a varying proportion of the apex of the triangular blade, and by partially grinding the sides adjacent to it. When seen from the front, the bit has the appearance of a shallow angular U with divergent sides, and the implement makes a cut resembling that of a gouge rather than an adz. In a few specimens the inner side of the bit is more or less hollowed, as in European gouges. (See Pl. XLV, G, H.)

Adzes of the *toki kouma* type are relatively common in the Marquesas, forming about 30 percent of all the specimens observed. They are of all sizes and were employed for a variety of purposes from the hollowing of canoes and containers to cutting ornamental designs on canoes and house posts. One specimen, said to have been used for fine carving, is 7 inches long, with a width of about $\frac{1}{4}$ of an inch at the bit. It seems certain that heavy, narrow-bitted *toki kouma* were also used in quarrying and dressing the large stone slabs employed in many Marquesan structures.

TANGLESS ADZES

The tangless adzes include a great variety of blades. The larger ones are probably true adzes while the smaller may have been either adzes or chisels. In cross section they range from nearly rectangular to triangular and in finish from a high polish on all surfaces to a simple grinding of the bit. In all examples seen the sides converge more or less toward the poll, which in some specimens is rounded or almost pointed. The bevel of the edge is in every case ground from the narrow side of the implement, which rests against the haft. In the larger specimens, the whole implement frequently has a well marked backward curve. (See Pl. XLVI, A.)

Adzes of this type are more numerous in the Marquesas than those of any other class. They are variable in size, outline, and cross section and appear to grade imperceptibly into the simple tanged adzes. The tangs of some specimens are so slight that it is difficult to determine in which class they should be placed.

UNCLASSIFIED ADZES

There are a few Marquesan adzes which defy classification and deserve individual descriptions.

A large adz $8\frac{7}{8}$ inches long with a maximum thickness of $1\frac{1}{2}$ inches is shown in Plate XLVI, B, 1. The poll is $2\frac{1}{2}$ inches wide and has across its center a well marked ridge. The bit has the remarkable width of $7\frac{1}{4}$ inches. The blade is rectangular in cross section and has been smoothly ground on all surfaces. The bevel is ground at a long angle, making a thin blade unsuitable for heavy work and it is hard to see for what purpose an implement of this sort could have been employed. The specimen is heavily patinated, indicating a considerable age.

The adz illustrated in Plate XLVI, B, 4 has a thin, flat, completely polished blade of beautiful workmanship. It is 3 inches long, with a thickness of less than $\frac{3}{8}$ of an inch and a width of about one inch at the top and $1\frac{3}{8}$ inches at the bit. The edge is ground with a flat well-marked bevel, and the angles formed by the juncture of the sides with the inner surface have been rounded off.

A large adz of remarkably fine workmanship is shown in Plate XLVI, B, 2. In general outline and form of tang it conforms to the *toki kouma* type, but the sides below the tang diverge rather rapidly, forming a broad bit instead of the narrow one normal in implements of that type. The lower side of the bit is considerably hollowed, giving to the cutting edge a well marked curve. The dimensions are: length, $11\frac{1}{2}$ inches; length of tang, 4 inches; maximum thickness of blade, $2\frac{3}{4}$ inches; width at upper end, 2 inches; width at bit, $3\frac{1}{4}$ inches. This specimen was purchased in the island of Ua Huka and is said to be of local material and workmanship.

The still more curious adz shown in Plate XLVI, B, 3, is the largest Marquesan adz known to the author, being $14\frac{1}{2}$ inches long and weighing slightly over 6 pounds. The upper end is formed into a well marked tang $4\frac{1}{2}$ inches long. Below this tang the shaft is triangular in cross section and of uniform size to within $4\frac{3}{4}$ inches of the bit. From this point the inner surface slopes forward at an angle of 40 degrees, while the sides broaden out and the outer edge slopes slightly backward. As a result of this the inner ground surface of the bit is oblong, the outer triangular. The whole surface is heavily patinated indicating an age greater than that of most of the specimens in the collection.

On Plate XLVI, 5 is shown a small and crudely made blade $3\frac{1}{4}$ inches long, one inch wide and one inch thick. The shaft is triangular, but with the base of the triangle forming one side of the implement so that its plane is across that of the cutting edge. The bit appears to be ground equally from both sides, as in an axe, and the cutting edge forms a distinct angle with the axis of the implement, as in

a turner's chisel. The shaft, either from accident or intention, is curved to fit the hand accurately, and the whole surface shows a slight but even polish of the sort acquired through wear, so that it is probable that the implement was never hafted.

COMPARISON OF MARQUESAN ADZES WITH OTHER POLYNESIAN TYPES

A thorough comparative study of Oceanic adzes would, the author believes, yield results of great ethnological value. Such a study is beyond the scope of this paper, but it seems well to point out the features which distinguish Polynesian adzes as a class from those used in Melanesia, and to indicate the distribution of the various Polynesian types. No satisfactory information is available for some parts of Polynesia, but the conditions appear to be as follows:

Melanesian adzes as a class are oval or elliptical in cross section, with smoothly rounded contours, and nearly all of them are completely ground and polished. The use of a distinct tang is unknown. Polynesian adzes, on the other hand, are triangular to rectangular in crosssection with surfaces composed of a few large planes meeting at sharp angles. New Zealand appears to have been the only locality in which the grinding and polishing of all surfaces was normal. Fully ground specimens are fairly common from Tonga, the Society, Austral and Cook groups, and from Easter and Chatham Islands, but are less numerous in collections than those which are at least partially rough. In Hawaii and Samoa fully ground adzes are almost unknown, while in the Marquesas complete grinding is practically limited to the *toki aa* type. In Tonga there appear to be two quite distinct types, one of which is clearly Melanesian while the other is an angular tangless blade of Polynesian character. Adzes of Melanesian contour and finish are present in collections from New Zealand, Easter Island, Chatham Island and rarely from the Society Islands. It thus appears that, broadly speaking, adzes of Melanesian type are present in all those localities in which there is a marked tendency toward complete grinding of recognizably Polynesian forms, while they are lacking in regions where complete grinding is rare or absent. It seems probable, therefore, that this feature is everywhere referable to a Melanesian influence, either direct or transmitted, and that the original Polynesian implement was ground, at most, upon the bit and outer face.

The angular Polynesian adzes may be divided into two main classes, tanged and tangless, each of which contains a number of subtypes. Tanged adzes are present in all the marginal Polynesian areas and extend as far west as the Cook Islands but they are rare in Samoa and absent in Tonga. They are divided into well marked local types: the Hawaiian type, the Southwestern type and the New Zealand type.

The Hawaiian type is characterized by a rectangular or nearly rectangular cross section, relatively thick blade, and grinding upon the bit, or the bit and outer surface only. Fully 90 per cent of the Hawaiian specimens have this form, but its only occurrence outside that group appears to be in the Marquesas, where it is one of the rarer forms (Pl. XLV, *D*).

The southeastern type is characterized by a triangular or subtriangular cross section, a relatively thin blade with a long bevel, and a more or less distinct shoulder where the blade meets the tang. It is often completely ground, and is normally better finished than the Hawaiian type. This is the dominant form in the Society, Austral and Cook islands, and in Easter Island, and is not uncommon in the Marquesas, although the specimens from that locality are inferior in finish to those from further south. Several examples of this type are known from New Zealand but it is lacking in the Chatham Islands and in Hawaii. (See Pl. XLV, *A-C*.)

The New Zealand type is characterized by a rectangular or nearly rectangular cross section, approaching in this respect the Hawaiian type. It is distinguished from the Hawaiian type by its thinner blade, rounded tang, and by a more or less complete grinding of all surfaces. It does not seem to occur in any other part of Polynesia although certain large adzes from the Chatham Islands may be a variant of this type.

The *toki aa* appears to be about equally common in the Society Islands and the Marquesas with related forms in the Cook and Austral islands and possibly in Easter Island. It is lacking in New Zealand and Hawaii. It is impossible to fix its point of origin, but the complete grinding characteristic of the type is at variance with the ordinary Marquesan practice and it seems probable that it was introduced into that group from the south.

The *toki kouma*, with slight modifications, is found throughout the same range as the *toki aa*. A very few examples come from New Zealand. It is entirely lacking in Hawaii although a few chisels from that locality have a slightly similar blade and bit form. Some examples from southeastern Polynesia and New Zealand are completely ground. The type is numerically important only in the Marquesas, and this, coupled with the fact that all Marquesan *toki kouma* show the rough finish characteristic of the group, may indicate that it was developed there. The occurrence of adzes like that shown in Plate XLVI, *B*, 2, in which a blade and tang of *toki kouma* type are coupled with a broad bit, lend support to this theory.

The *toki kouma* is sharply set off from all other Polynesian adz types by the fact that it was hafted with the base of the cross section triangle against the handle, a reversal of the ordinary practice. Among true adzes the nearest

Oceanic approach to the *toki kouma* form of blade and bit seems to be found in certain shell specimens from Micronesia.

Tangless adzes have been reported from every part of Polynesia for which there is satisfactory information. In New Zealand a well marked local type had been developed, with a thin blade of rectangular or nearly rectangular cross section ground on all surfaces. In Tonga also there appears to have been a distinct local type, characterized by a short, broad blade, relatively thin, and completely ground. The bulk of the Tongan specimens, and of the tangless adzes from all other parts of Polynesia, show such uniformity that one is forced to conclude that all were made after an established pattern. This universal type is characterized by quadrangular to subtriangular cross section, sides which converge toward the poll, and grinding upon the bit and outer face only. (See Pl. XLVII, A.)

The dominance of the two main adz types—that is, tanged and tangless—shows the same distinction between Samoa and Tonga on the one hand and marginal Polynesia on the other, which we have already noted in our study of houses and canoes. The tanged adz is dominant everywhere in marginal Polynesia, and lacking in the Samoa and Tonga. The tangless adzes throughout marginal Polynesia may be explained as a result of western Polynesian influence, but their comparative rarity in the Society Islands where western Polynesian influence is strong, and their frequency in the Marquesas, where such influence appears slight, is an argument against this. The wide distribution of tangless adzes, their relative simplicity and ease of manufacture, and their remarkable uniformity wherever found, suggest that they represent a primitive type originally known to all the Polynesians. Specimens collected in the Marquesas link the tangless adzes with both the rectangular and triangular tanged forms and both probably have been developed from the tangless adz.

The Polynesian distribution of the Marquesan adz types would seem to indicate more or less contact with the Society Islands and Southeastern Polynesia in general, while the remarkable similarity of some of the specimens to normal Hawaiian forms suggests an influence from that group also. The importance of the tangless adz may indicate a western Polynesian influence, but is more easily explained as a primitive survival.

METHODS OF HAFTING

Different methods were employed in the hafting of chisels and adzes. No really ancient specimens of either type were seen but the hafted adzes studied agree with the descriptions of informants and are almost identical with the iron bladed adzes still in ordinary use throughout the group, so they are probably good reproductions of the ancient form. The data in regard to the hafting of

chisels is much less satisfactory. It is certain that the Marquesans, like the Maori, did employ hafted chisels, but no old specimens are now extant.

ADZ HAFTINGS

Only three hafted adzes were seen and one of these was made by the informant who made the chisels. The other two specimens were of considerable age, and all three agreed closely in form. The blades in all three specimens were of *toki kouma* type. The use of other forms of blade may have necessitated slight changes in the form of the haft.

Adz handles were usually made of *fau* wood, care being taken to select old trees as the young shoots are too soft and brittle for the purpose. In one chant the use of *noni* roots is indicated and in another that of *mio* wood (Handy personal correspondence). A branch and a section of the trunk immediately above it were detached, and the natural hook thus obtained was worked down into a more or less smoothly rounded elbow having the two sides of unequal length. The long arm served as the handle and was made from the branch, the short arm to which the blade was attached, was made from the trunk. The entire haft was thickest at the curve of the elbow, the diameter of the two arms gradually decreasing toward their ends. A socket for the blade was cut in the outer surface of the short arm. The upper end of this socket was at about the level of the inside of the curve at the elbow. The form of this socket naturally varied with that of the blade it was intended to accommodate. In all the specimens seen, the socket was flat, running the entire width of the handle and being cut squarely across, or only slightly rounded at the upper end, but many of the blades collected must have required a socket semicircular or triangular in cross section, and tapering toward the upper end so as to fit the contour of the blade accurately.

The tang was wrapped in two or three thicknesses of *tapa*, which were so arranged that they intervened everywhere between the stone and the lashings, and socket. The purpose of this wrapping was to increase the friction of the lashings and keep them from loosening. The lashings themselves were made of three plait coconut fiber cord of medium weight, and although carefully laid on were not ornamental in the specimens seen. According to informants ornamental lashings of red and black sennit were used on at least some special adzes. (Handy, personal correspondence.)

The arrangement of the lashings in two specimens was very simple, consisting of a single cord beginning at the lower end and passing round the blade and haft. The loose lower end of the cord was carried back up the inner surface of the haft and held in place by the subsequent turns of the lashing. The upper end was thrust down under the two or three uppermost laps on the inner surface

of the haft, brought out, and pulled taut. In the third specimen, which was made by the Atu Ona informant, the lashings were laid on in alternate diagonal loops beginning at the bottom. These loops crossed each other along the line of the middle of the tang, giving an ornamental effect. The last two binding loops at the top were horizontal, while two more loops were passed around the haft above the blade. The end was made fast by tucking it under the last few turns of cord on the right side. (See Pl. XLVIII, A.) The maker insisted that this form of lashing was the ancient one and it is probable that several forms of ornamental lashing were originally in use. One of these, mentioned in a chant for the making of a boy's first adz, was called the *humua tane oa*, and was probably derived from a string figure of the same name. (Handy, personal correspondence.)

Adz blades were rarely if ever set at right angles to the handle, the included angle in modern specimens being 70 degrees or less. The handles of ordinary adzes were short, those used at the present time are commonly less than a foot long, but blades used for heavy work, such as roughing out canoes were formerly provided with long hafts. In Nuku Hiva an adz with a four foot handle is said to have been used for this purpose. (Handy, personal correspondence.)

The adjustable socket, common in Micronesia and in some parts of Melanesia, seems to have been unknown in the Marquesas, although it was known and used to a limited extent in Hawaii. It is lacking in other parts of Polynesia, and the Hawaiian examples are probably referable to a Micronesian influence.

CHISEL HAFTING

No specimen of the ancient Marquesan chisel hafts was found, and the following description is based on information obtained in the group and upon two reproductions made by Hapuan, of Atu Ona, Hiva Oa. In both these reproductions the handle consists of a straight rectangular stick of wood between 10 inches and 11 inches long, 1 inch wide, and $\frac{3}{4}$ inch thick. The wood in one is *fau*, in the other *teman*. A socket for the blade is cut on one side of the lower end of the shaft. When in position the blades project beyond the handle for about two-thirds of their length. The lashings are of sennit, arranged as in the more elaborate form of adz lashing, except that the cord is passed around the handle several times above the socket. (See Pl. XLVIII, B.)

USE OF ADZES AND CHISELS

No stone adzes have been used in the Marquesas for many years, but as the form of the modern iron-bladed tools is almost identical with that of the ancient ones it seems probable that the method of use was the same. At the present time every skilled workman owns two or more adzes, at least one of which has a

curved edge. Each of these adzes has its special use and in doing any piece of work, as the shaping of a bowl, great care seems to be taken to use the proper tool for each stage of manufacture. In working any surface a series of light glancing blows are struck instead of two or three heavy ones. Informants agree that this was also the ancient system. The blade of a stone adz could easily be shattered by a heavy direct blow, and it is related that when a *tuhuna* who had been employed to make some object became dissatisfied with his pay or working conditions he would strike a heavy blow, breaking his adz, and with this as an excuse, refuse to finish.

The small straight bladed adzes are also used as planes. The handle is grasped at the curve, with the blade below the hand, edge forward, and the tool is pushed along the surface of the wood, removing a thin shaving. Stone adzes are said to have been used in the same manner.

Very little data could be obtained on the method of using the hafted chisels other than that they were used to hollow drums and cut the lashing holes in canoe parts. They were struck upon the upper end of the shaft with a *toa* wood mallet like that used in caulking canoes. (See Pl. LVI, B.)

GOUGES

The Marquesan collection in the Bishop Museum includes four implements uncommon to the group, and it has been thought best to describe them separately under the head of gouges although it can not be said with certainty that they were not hafted and used as adzes. The implement shown in Plate XLVII, B, 2 is $6\frac{3}{4}$ inches long, $1\frac{3}{4}$ inches wide at the bit and $1\frac{1}{4}$ inches wide at the upper end. It is almost semicircular in cross section. The cutting edge is curved, but the lower side of the bit, which is ground with a well marked bevel, is flat. The implement fits the hand well and does not appear to have been hafted.

Only slightly smaller than No. 2 and with a similar bit, gouge No. 3 shown on the same plate is distinguished from it by having parallel sides.

No. 4 on the same plate shows a small specimen whose shaft has been broken. The bit has a width of $11/16$ inches and its lower surface is slightly concave. The body of this gouge is almost circular in cross section and well polished throughout, although the marks of the chipping have not been completely obliterated. The bit shows use and sharpening, and the implement was probably a carving tool.

No. 1 on this plate is completely ground and has a narrow upper and broad lower surface, both of which are flat, while the sides are somewhat rounded. The upper surface narrows toward the rear so that the blade is almost triangular at the butt (the point of greatest thickness) and the whole shape is reminiscent of

the lower part of a narrow *toki kouma* whose tang has been broken off. The implement appears to be complete however, and shows no signs of hafting. It is possible that this implement marks a transition from *toki kouma* to gouges and that the two classes of implements are related.

KNIVES AND SCRAPERS

Marquesan knives were usually made from bamboo or shell, and shells were used as scrapers, but stone knives and scrapers also existed. In the absence of iron tools, stone knives have been used as a makeshift until comparatively recent times. Pere Simeon Delmar, head of the Catholic Mission in Taiohae, Nuku Hiva, has witnessed the manufacture of stone knives. He says that the knives, often six to eight inches in length, were made from flakes of a special variety of phonolite, which were detached from a core by a single sharp blow with a rounded stone held in the hand. The natural fracture gave a fairly sharp edge to the flake and it was used without retouching or hafting. When the edge became dull from use, the implement was thrown away. In M. Delmar's experience these stone knives were used only to open and scale fish. Many phonolite flakes were found in old village sites, but their certain identification as knives is impossible. (See Pl. XLVIII, G.)

Two stone artifacts were collected which appear to have been scrapers. One of these, found in an old village site, is a large semicircular spall of some basaltic rock which has evidently been retouched along its lower edge. Its form is not unlike that of some of the shell scrapers used for tapa making. (See Pl. XLVIII, E, 1.)

The second specimen was collected on the island of Ei Ao. It is a thin spall of phonolite which has been worked into rectangular form and dressed along the outer end and one side with an abrupt retouch. This implement appears to be complete, and is much too thin and carefully worked to be a reject from the adz workshops. It was identified by natives as a scraper. (See Pl. XLVIII, E, 2.)

RUBBING STONES

The Marquesans used rubbing stones in the manufacture of various wooden objects and in dressing the large stone slabs which are a common feature of their masonry. The large rocks upon which adzes were ground and polished have already been described (p. 321) and mention has been made of the probable use of whetstones, but it is uncertain whether rubbing stones were used in the manufacture of other stone artifacts. The modern makers of *popoi* pounders deny their use, and none of the ancient artifacts show a finish which could not have been produced by careful pecking and a final polishing with sand. The large flat

surfaces and true angles of the stone slabs, on the other hand, could hardly have been produced with any other implement. No information as to the form or material of these stone dressing tools was obtained, but it seems probable that they were fragments of cellular lava having a more or less flat, natural surface.

The rubbing stones used in wood working were of two types, abrasive stones, which were used to obliterate the marks of coarser tools and to some extent to shape the object, and burnishing stones, which were used to give a final high polish. All the abrasive stones seen were made from more or less water-worn lumps of coral or coralline limestone, but it appears probable that pebbles of the finer grained cellular lavas were also employed. The texture varied considerably and at least one specimen was so hard and smooth that it could have had little abrasive effect. Several rubbing stones of increasingly fine grain were used in finishing a given object, the last grinding stone being followed by the burnisher. (See Pl. XLVIII, C.)

Burnishing stones were small pebbles of even-textured, rather soft rock which were used only in the final stage of manufacture and had no abrasive effect. They were rubbed rapidly back and forth upon the surface to be polished, the workmen exerting a fairly heavy, even pressure. In time they acquired a peculiar glassy polish resembling that of a gastrolith. The smoother the implement the better the finish which it could impart to a bowl, so old specimens were highly prized. (See Pl. XLVIII, D.)

PERFORATED STONE DISKS

Two perforated stone disks were collected by the expedition, one, of unknown history, being obtained in the valley of Hane, Ua Huka, while the second was found lying among some skulls in a *me'ae* in the valley of Hanapaoa, Hiva Oa. Both specimens are made of rather porous lava. (See Pl. L, A, 1-2.) The dimensions are as follows: No. 1, length $3\frac{3}{8}$ inches, width $2\frac{7}{8}$ inches, thickness 1 inch, width of perforation at surface 1 inch, width of perforation at center $\frac{3}{16}$ of an inch. No. 2, length 4 inches, width $3\frac{1}{2}$ inches, maximum thickness $1\frac{3}{4}$ inches, minimum thickness $1\frac{1}{2}$ inches, width of perforation at surface $1\frac{3}{8}$ inches, width of perforation at center $\frac{5}{8}$ of an inch. The perforation in No. 1 is almost perfectly centered, that in No. 2 noticeably nearer one end than the other. In both, the perforation appears to have been pecked rather than drilled, and is formed by two conical pits which meet in the middle of the objects in a rough edged orifice. The surfaces of both specimens are rather carefully smoothed.

Both objects were identified by an Atu Ona informant as weights for pump drills, but this explanation does not appear entirely satisfactory. The pump drill was a common Marquesan tool, and if such weights were used one would

expect to find many specimens, whereas perforated stone disks are so rare that most natives had never seen one and could offer no suggestion as to their use. The actual specimens are, moreover, poorly adapted for this purpose as No. 2 is quite asymmetrical while the perforation of No. 1 is much too narrow to admit a drill shaft. Perforated disks of this sort are also found in Hawaii as a rare form.

SINKERS

Stone sinkers were used with at least one of the Marquesan types of fish-net, but specimens deliberately shaped for this purpose are extremely rare. Only one object which could be identified as a net sinker was seen. This was a rather crudely finished specimen of coarse lava having an almost globular body terminating in a short knob with a somewhat expanded outer end, in which a shallow transverse groove was pecked. It was about $2\frac{3}{4}$ inches long and $1\frac{3}{4}$ inches in diameter. The neck and the single groove across the center of the top are said to have served for the attachment of cords. According to the owner of this specimen, an unusually intelligent native, sinkers of this type were attached to the lower edge of the long seines used in turtle fishing.

A second specimen, clearly related to this form but of such fine finish that its purpose was probably ceremonial rather than utilitarian, was seen in a collection in Taiohae, Nuku Hiva. The body was between 3 and 4 inches in diameter and almost perfectly spherical. The neck was very short and oval in cross section and each of the two parts into which the end was divided had been carved into a flat tiki face directed upward. The specimen appeared to be made of phonolite or some other equally hard and fine grained stone and had been carefully polished on all surfaces. Its heavy patination indicated a considerable age. This sinker, if it is a sinker, bears a remarkable resemblance to certain specimens found near the East Cape of New Zealand, which are identical in outline and in having two heads carved upon the projections at the top. A crudely made object of the same type, now in the Museum of the University of Pennsylvania, is shown in Plate XLIX, *A-B*. The New Zealand sinkers differ from the Marquesan examples in having the body of the sinker covered with elaborate carving.

A stone object in the collection of Mme. Maleius, in Ta'aoa Hiva Oa, can probably be classed as a sinker. It is oval in outline, with one flat and one convex side. Down the center of the convex side a groove has been pecked, giving the whole much the form of a coffee bean. The material is a rather coarse lava, and the whole finish is rough. As far as known no other object of this sort has been reported from the Marquesas and the owner, who was thoroughly conversant with native matters, could offer no suggestion as to its use.

In Hawaii artifacts in every way identical with this object are quite common and were used as sinkers for squid hooks. The Marquesas was an important point of call for whalers in early days, and the first missionaries to establish themselves in the group were Hawaiians, so it is probable that this object was imported from that group during the historic period.

ANCHORS

Native accounts of the ancient fishing methods mention the use of anchors, but it seems probable that these were simply rough stones. A single worked specimen was seen in Taiohae, Nuka Hiva. It consisted of a conical stone of oval cross section about 10 inches high and 7 inches in diameter, through the upper end of which a hole about $\frac{3}{4}$ of an inch in diameter had been pierced. The natives were unable to identify this specimen, and as it was found among the debris of a trader's store it may be either of European workmanship or due to European influence.

PIPES

The use of tobacco in the Marquesas is almost certainly post-European, but the plant was cultivated there very early in the historic period. Clay pipes in burial caves that contain no other evidences of European contact indicate that they were among the earliest trade objects and most of the stone pipes appear to have been made at a time when the native culture had undergone little, if any, change. The clay pipes referred to are clearly the prototype from which the stone pipes were evolved, but the Marquesan pipe makers were no slavish imitators and their work shows considerable originality.

The material used was a rather soft, even-textured volcanic rock, and the shaping was probably done with metal tools, although the fine finish of most of the specimens makes it impossible to say whether such tools were always used. The bowl form was like that of the European clay pipes of the early nineteenth century, but the other features vary greatly. The simplest form is shown on Plate XLIX, C. It consists of a simple bowl $1\frac{3}{8}$ inches long and about $\frac{3}{4}$ of an inch wide, with a hole pierced in one side for the stem. The bottom of the bowl is decorated with a short cylindrical knob.

A more elaborate specimen, seen in Hanahehe, Hiva Oa, consisted of a similar bowl, without the knob, which had at the bottom two projections $\frac{3}{8}$ of an inch long, placed directly opposite each other. Both these projections were drilled to take stems. The bowl was covered with lightly incised designs which had been almost obliterated by handling. The use of multiple stems appears to have been rather common and according to reliable informants some specimens had as many as four.

By far the most elaborate pipe seen was in the possession of Mr. Frank Varney of Atu Ona, Hiva Oa. It is shaped like the bowl and fore-stem of an ordinary straight brier pipe, but has a tiki figure carved against the curve of the bowl in three-quarter round. (See Pl. XLIX, D.) The convention of this little figure is curious; the eyes are indicated by raised circles on either side of the head, and there is no distinct mouth or nose. A small beak-like projection at the bottom of the head, between the eyes, suggests that it may represent a bird. A hole has been drilled between the figure and the pipe bowl at about the level of the waist. This pipe is known to be very old and has been in the possession of a single family in Atu Ona for at least three generations.

BOWLS AND TRAYS

Stone bowls and trays are rare in the Marquesas, and the few specimens extant vary greatly in form and finish. The larger objects of this sort are usually quite crude. Some of the smaller bowls, on the other hand, show great skill in manufacture and are well finished and even decorated.

The largest object of this sort seen was a so-called tray which was built into the upper edge of a small platform in the *tohua* of Hutuhu'u, valley of Taipi-Vai, Nuku Hiva. It appeared to be a large fragment of a lava bubble which had been smoothed and slightly excavated on the inner surface, the outside being left rough. It was 3 feet, 6 inches long, with an average width of 2 feet, and an external depth of from 6 to 9 inches. Its form was likened by the natives to that of a canoe, a small natural projection at one end being pointed out as the prow, but the depression was really roughly rectangular. It is said that the bodies of victims who were to be eaten were laid upon this tray, but no other data could be obtained.

Another large bowl or tray of an altogether different form and use, was seen in the island of Tahu Ata. It apparently had been made from an oval water-worn boulder, the outer surface left unworked. It was seen in the course of a visit so brief that exact measurements were impossible but the dimensions were approximately as follows: length 2 feet, 6 inches, width 20 inches, external depth 18 inches. The depression was circular, narrowing toward the bottom, and was about 14 inches in diameter and one foot deep. The rim was flat and rather carefully smoothed. Upon one end of the rim there was a cylindrical projection about 3 inches in diameter, and of the same height, which was said to be the base of a small tiki figure about one foot in height which was carved in one piece with the bowl. This little figure had been broken off and carried away many years ago. The bowl was built into the pavement of a large dwelling *paepae*, but informants were not certain that this was its original position. It

was so heavy, however, that several men would have been required to move it and it must have been fixed in some special place. It was said to have been used to dye tapa with saffron.

A third stone bowl was seen in the valley of Pua Ma'u, Hiva Oa, and is known to have been the property of the last queen of that valley. It was made of red tuffa of the sort ordinarily employed for large stone slabs, and was very roughly finished. The dimensions were as follows: diameter, 18 inches; external depth, 14 inches; thickness of rim, 3 inches. It was said by the owner to have been used to keep fire in, in the house at night, but this seems to have been an unusual practise and no other bowls of the sort were known to the natives.

A peculiar stone tray was collected in the valley of Taipi Vai, Nuku Hiva. This specimen is made of rather coarse lava, worked all over but poorly finished. The outside is decidedly asymmetrical—somewhat oblong in shape with rounded ends. One end of the tray has a curious flat projection running from a short distance below the rim down the outside of the bowl to the bottom. This projection is $5\frac{1}{2}$ inches long, $3\frac{1}{8}$ inches wide at the upper end and 2 inches wide at the lower end, at the top it is 1 inch thick, at the bottom $\frac{1}{2}$ an inch. The upper end and sides of the projection are somewhat undercut, and a shallow transverse groove runs across the lower end $\frac{3}{4}$ of an inch above its tip. The internal depression of the tray is nearly rectangular, 11 inches long, $7\frac{1}{4}$ inches wide and $\frac{3}{4}$ of an inch deep. The bottom is flat, the sides curving upward abruptly. The outer surfaces of the tray recurve slightly at the rim. The dimensions of the tray are: length, $14\frac{5}{8}$ inches; width, $9\frac{1}{4}$ inches; maximum thickness, $4\frac{1}{2}$ inches. This tray was used by its owner to grate saffron root and was described by him as an heirloom. There is good evidence, however, that he found it while clearing land only a short time before its purchase and its ancient use remains uncertain. (See Pl. I, B-C.)

The specimens described have all been of large size and rather crude workmanship. Certain fragments in the collection of the Bishop Museum, however, prove that there were in the group small and finely made stone bowls. No. B3699A is a fragment of a bowl or tray, its size being too small to make exact determination possible. The material is some soft, rather close-grained, grey stone, and the whole surface, including the fracture, is heavily patinated. The walls are about $\frac{7}{8}$ of an inch thick, and the internal depression $\frac{3}{8}$ of an inch deep at the rim. The rim is flat, and the object appears to have been finely finished on all surfaces. Another fragment (No. B3699B) is of a small circular bowl about $6\frac{3}{4}$ inches in diameter and $2\frac{3}{4}$ inches deep. The walls are $\frac{3}{8}$ of an inch thick at the rim and about $1\frac{1}{4}$ inches thick at the bottom. The outer sides recurve slightly at the rim, which is flat with rounded edges. This

bowl was made of some rather hard close grained stone and was finely finished inside and out. Still another specimen (B3699C) appears to be a fragment of a rather shallow bowl 8 to 10 inches in diameter. It is made of a soft grey stone, possibly an indurated ash. At the lower end of the curve it bears a chevron carved in high relief along whose center there is a single incised line. It seems probable that this formed part of a zigzag band running around the bowl, but the fragment is too narrow to tell certainly. No. B3699D is a fragment from the side of a rather large and heavy bowl or tray having a bottom thickness of about one inch. The outer surface was smoothly finished and decorated with closely spaced incised lines forming simple curvilinear designs. (See Pl. XLIX, E.)

POUNDERS

INTRODUCTION

Pounders were, with the possible exception of adzes, the commonest of Marquesan stone artifacts, and they still form a regular part of the domestic equipment of all native households. In ancient times they appear to have been manufactured to some extent in all the valleys but even in prehistoric days the superiority of the stone found in Ua Pou and Ua Huka had led to a localization of the industry. The finished implements were traded from these islands to the rest of the group. The manufacture of *popoi* pounders has continued in Ua Huka down to the present time, and shortly before the war large numbers are said to have been made for a German trading company which sold them in their stores throughout the group and even in Tahiti.

At the present time the making of *popoi* pounders appears to be essentially a spare time industry, the natives working upon them when they have nothing more pressing to do.

For the pounders three varieties of stone were formerly used, all of which appear to have been rather soft, even grained magmatic rocks. The best grade was called *ovao*, a grey rock, fine grained, strong and light. The second best was called *puhite'a*, and the third best *patako*. All these varieties are said to have been obtained from the high part of the island lying to the east of the valley of Hokatu, but as boulders in two other valleys were pointed out as good pounder stone, it is probable that the deposits were rather wide spread. The stone does not appear to have been regularly quarried, but was obtained from rock slides and stream beds.

The only tool used in making modern *popoi* pounders is an ordinary steel axe, and even the finishing touches are given with this unwieldy instrument. The process of manufacture is as follows:

An irregular piece of stone about three times the size of the finished implement is roughed out with heavy blows of the axe until it becomes a cone. (See Pl. LI, A, 1.) This cone is then worked down by light blows on all sides until the general form of the finished implement is produced. This is then smoothed by light, even blows with the corner of the axe until all the contours are perfect. The neck and body of the implement are then shaved with the edge of the axe until the scratches left by the last process are obliterated. The head

and base are left rough. The smooth surface of some new and unused specimens would seem to indicate the use of some sort of abrasive for the final finishing, but informants who were themselves makers insisted that this was not the case. The body of the implement is sometimes rubbed with a mixture of coconut charcoal and oil which gives it a shiny black finish contrasting pleasantly with the grey of the head.

Informants of Ua Huka insist that the ancient process of manufacture was essentially the same except that stone adzes were employed instead of the modern steel axe. The stone used on Ua Huka could probably have been worked in this way and the information may be correct for this locality, but in other islands a variety of rock was employed, some of which could hardly have been worked with stone adzes. The heads of many of the old pounders show marks which make it seem certain that they were finished by pecking.

MODERN POUNDERS

The modern commercial pounders all conform to a single well-marked type (Pl. LI, A, 2).

The pounders are characterized by a neck of oval cross section which expands to form the head and the body of the implement. There is no clear line of demarkation between these parts and it is impossible to say where one ends and another begins. From the neck the body flares outward toward the base, which is circular, so that when seen in profile the sides of the pounder appear concave. The bottom is convex, with a rather low curve, and is always left rough. The head is oval in horizontal cross section, the lower part contracting gradually toward the neck. The upper part has the form of a high rounded dome and is divided into two equal lobes by a transverse groove which extends down either side almost to the point of maximum width of the head. The surface of these lobes is left rough, apparently with ornamental intent, and the whole form is clearly phallic.

ANCIENT POUNDERS

The natives themselves classify pounders according to use, recognizing four distinct classes as follows: (1) *popoi* pounders, (2) pounders for infant food, (3) salt pounders, (4) children's pounders. They also recognize certain of these implements as forming a fifth distinct class whose use has been forgotten. As these native classifications according to use are correlated with differences in the size and form of the implements, they will serve as the basis for the present descriptions.

POPOI POUNDERS

Popoi pounders are numerically much more important than those of any other class, practically all large pounders belonging under this head. They are divided by the natives on the basis of size and weight into men's and women's pounders, the larger implements being used by the men. All *popoi* pounders are known by the generic term *kca tuki popoi* (stone to beat *popoi*) but those having flat heads are also known as *opu* (stomach). The phallic forms do not appear to have had special names. The term applied to the tiki-headed pounders was descriptive, meaning carved pounder.

All *popoi* pounders agree with the commercial pounders in the form of the body and base. The necks range in cross section from oval to round, but the differences appear to be more or less accidental and are not correlated with other features. The range in size does not appear to have been very great, the ancient specimens seen varying in height from 7 to 8½ inches and in base diameter from 4½ to 5⅝ inches. The variation is about the same in all subtypes. The subtypes are therefore based entirely upon differences in the form and decoration of the head.

The simplest form of *popoi* pounder appears to be the flat topped type called *opu*. In the plainest specimen collected (Pl. LI, B, 2) the neck is circular in cross section and expands only slightly at the top, the upper end being slightly convex. The curve of the bottom is unusually high. More commonly in this type the neck is more or less oval in cross section and the upper end shows a more marked expansion, its surface being flat or slightly concave. (See Pl. LI, B, 1.) In one specimen, which could not be obtained, the ends of the oval head projected beyond the neck in finely made flat flanges not more than one-fourth inch thick. A further modification of the *opu* type consisted in encircling the neck some distance below its upper end with a raised ring. (See Pl. LI, B, 3.) In view of the shape of one of the specimens of phallic form it seems probable that the idea here is phallic also. *Popoi* pounders of the *opu* type were seen only in the island of Hiva Oa, and as all the specimens were of local rock it seems possible that this was peculiar to Hiva Oa.

The phallic type of pounder is much more common than the *opu* type and appears to have been the dominant form throughout the Marquesas. It may be subdivided into simple phallic representations, and the tiki headed pounders, which are clearly derived from the simple phallic form.

A single specimen (Pl. LII, C) may link the phallic pounders with the ringed specimens of the *opu* type. The neck of this implement is encircled a short distance below its upper end by a raised, smoothly rounded ring. The space above this ring is dome shaped and ungrooved. The whole appears to be a phallic representation.

The normal form of phallic pounder is well illustrated by the specimen shown on Plate LII, A. In this the neck expands smoothly to form a head of almost rectangular cross section, there being no line of demarkation between the two parts. The transverse groove is deep and the sides slope inward steeply. The ends are almost vertical and the top on either side of the groove is flat. The whole surface is treated as a series of slightly convex planes which meet in well marked angles. This angularity is most pronounced in No. 1. Most of the phallic pounders seen had this form and it is probably the prototype from which both the modern commercial and tiki headed pounders have been developed.

Two phallic pounders, shown on Plate LII, B, differ slightly from this normal type. The head of No. 1 is oval in cross section, the sides slope inward

rather abruptly, and the ends are almost vertical. The top bears a longitudinal groove instead of the usual transverse one. In No. 2 the head is smoothly rounded, with a short transverse groove.

TIKI HEADED POUNDERS

Tiki headed *popoi* pounders represent the highest development of Marquesan stone working, the only objects which approach them in excellence being certain of the small stone figures. The expedition was fortunate enough to obtain five perfect specimens and the carved head of a sixth, while ten others were studied in private collections or from photographs. In all of these pounders the carving followed one or the other of two well-marked conventions and the series appears large enough to make possible a fairly accurate study of the type. In spite of their fine workmanship and present rarity tiki headed pounders were, and in some cases still are, used as ordinary household utensils. All informants agree that the carvings are purely decorative and have no religious significance.

In general form the tiki headed pounders agree perfectly with the angular headed type of phallic pounder already described, and it seems certain that they have been developed from these implements. According to informants the carving was done with sharks' teeth or rats' teeth, but the form of the carving tools and the method of employment have been forgotten. In the actual specimens the grooves of the carving are semicircular in cross section and exhibit a high polish.

The decoration consists of two heads, formed by carving a face upon each of the lobes of a phallic pounder of normal angular type. In carving these faces two distinct conventions were employed, one of which appears to have been rare, being shown by only three of the sixteen specimens. In the normal convention the features are carved in low relief and the decorated top is set off from the neck of the pounder by a well marked groove. Each of the faces covers the entire surface of a lobe, its center line being in the middle of the outer end. The mouths are broad, in the form of long narrow ovals with rounded ends. The tongue is shown as a narrow longitudinal ridge, and the lips are broad, with a flat or slightly concave surface. In one specimen there is a narrow band between the lips and the tongue which may represent the teeth. Immediately behind each corner of the mouth a small decoration in the form of a "V" is sometimes carved. The nose is broad and flat, with almost semicircular nostrils. The eyes are carved on the upper corners of the lobe and are directed toward the side rather than forward, and the space between them is disproportionately wide. The eyes are of the usual spectacle form—a raised ring encircling a convex center—and are connected to the base of the nose at the inner end and to the ear at the outer end by narrow raised bands. As a rule the eyes are horizontal, but some specimens show a slight upward or downward inclination. The ears are represented as double scrolls, and are so placed that their outer edges fall along the line of the inner edge of each lobe. There is a well marked groove above either eye. The top of the head may be either rounded or pointed, while in one specimen broad flat grooves have been carved along either side above the eye groove, giving the head a sharp central keel. The space on the side of the pounder below the ears and between the corners of the mouths of the two faces is filled with either one or two small block figures bearing incised designs. In one specimen (not shown) a small block figure of this sort is placed in the middle of the forehead of either face.

The characteristics of the rarer type of tiki headed pounder (Pl. LIV, A) are as follows:

The features are carved in high relief and the whole effect is that of two heads made in the round and placed back to back, the faces projecting out beyond the oval neck at either end. The mouth is narrower than in faces of the common type and has a greater vertical width. The lips are thin and rounded and the tongue broad and prominent. The nose is small and almost naturalistic in its proportions, and juts out from the face. The eyes are large, with upper and lower edges of differing curve, a high rim, and a well marked longitudinal ridge across the eye ball. They are directed to the side, and the rear corners slope downward and backward so steeply that the ears, shown as simple hooks, are at the level of the corners of the mouth. The top of the head is rounded and only slightly higher than the upper edge of the eye rings.

The finding of three specimens of practically identical form seems to indicate that these objects constituted a distinct type, but the natives can give no information on this point. The convention of the carving differs considerably from that employed on any other artifacts but is reminiscent of that of certain large stone heads used as architectural decorations. Pounders of this sort are certainly pre-European and it seems probable that they either had a special ceremonial significance, or were the product of some local school of carving which became extinct at an early time.

POUNDERS FOR INFANT FOOD

Special pounders were used to crush the fresh water shrimps which were fed to infants as a purgative before they were suckled for the first time. (See Pl. LIV, C.) They are smaller than the *popoi* pounders, and have an oval instead of a round base, only slightly concave sides, and no distinct neck. The top is oval in cross section and usually projects slightly beyond the body at either end. In the best made specimens the top is usually slightly hollowed along its center, but in one specimen it is smoothly rounded. In using these pounders, the body of the implement was grasped in the hand with the index finger extending lengthwise over the top, and the shrimps were crushed with a grinding motion rather than direct blows.

SALT POUNDERS

Certain small pounders are said by the natives to have been used for grinding coarse salt left in hollows of the rocks by the evaporation of sea water. These appear to have been fairly common in the island of Nuku Hiva but are rare or lacking elsewhere in the Marquesas. They are characterized by a long, thin headless neck, or body, which flares out rather abruptly at the base. The base is either round or oval. (See Pl. LIV, D.)

CHILDREN'S POUNDERS

A few very small pounders which were seen in the Marquesas were said to have been toys; although, as some of them showed considerable wear, they may

also have been used as pestles to grind medicines or pigment. According to informants little pounders of this sort were made for an adopted child in order that he might pound food for his pig. All those seen were miniature reproductions of *popoi* pounders, although never of phallic type. One specimen, of *opu* type, is only $3\frac{3}{4}$ inches high and 3 inches wide at the base. (See Pl. LIV, B.)

CONICAL POUNDERS

The natives recognized Conical Pounders as a distinct class, but they appear to have no name for them and can assign no special use; so the recognition is probably nothing more than a realization that these implements differ from all other pounders and cannot be placed in any of the regular categories. They are rare; only five examples were located.

The conical pounders are characterized by heavy conical bodies which entirely lack the slender neck and graceful bottom flare of ordinary *popoi* pounders, and by the peculiar finish of the upper end, which bears a short transverse grip. In four of the five specimens this part is carved. In the uncarved specimen, the grip is formed by two short cylindrical knobs which jut out from opposite sides of the top of the implement. Between their inner ends there is a rounded transverse ridge. (See Pl. LII, F.) Two of the carved pounders are large and two small. The size, shape and decoration of each pair are so closely similar as to indicate that they are either the work of the same artist or examples of an established type.

In the small pounders (Pl. LII, D) the grip is carved into a single human head, disproportionately large, with the face up.

The treatment of the head is decidedly naturalistic, the face being long and narrow with a projecting jaw. The mouth is almost circular, with thick rounded lips and a protruding tongue. The nose is high, with a sharp bridge; the cheeks sunken; and the eyes are in the form of long ovals, with a slight groove indicating the lower lid. The ears are indicated by shapeless knobs which are set above the level of the outer corner of the eye and do not appear to be connected to it. There is a suggestion of a smoothly rounded supra-orbital ridge. The head above the face is round and disproportionately short, its back projecting only slightly beyond the neck of the implement. In both specimens the execution is rather poor, the eyes being at slightly different levels.

In the large pounders (Pl. LII, E) the horizontal grip is divided into two equal parts by a transverse groove.

Each of these lobes is carved into a head, chin out. These heads, although worked out in less detail, are evidently much more closely related to these on the small pounders just described than to the ordinary Marquesan convention. They show the same projecting jaw, high nose, sunken cheeks, long oval eye, and knob ear. The mouth is not indicated. The carving is remarkably angular, suggesting the use of metal tools, but from certain details of the specimen examined it seems certain that they are pre-European.

These conical pounders offer an interesting problem, for they differ considerably from all other Marquesan types in both shape and decoration. The uncarved specimen was said by its donor to have been found in a sand dune in a small valley on the north side of Nuku Hiva. It is heavily patinated, suggesting a

considerable age. Of the carved specimens, one large and one small specimen are from Nuku Hiva and the other two from Hiva Oa.

In all five pounders the material appears to be local, and as the use of carved decoration on pounders is limited to the Marquesas, the theory of importation may be discarded. The heads carved on the small examples show a slight resemblance to those carved on the rarer type of tiki headed pounders, but the angularity of the features on the larger specimens finds no parallel in other Marquesan work. A similar angularity was noted, however, in some of the wood carvings in the Society Islands. The form of these specimens also finds a fairly close parallel in certain small specimens from Tahiti and in certain pounders of coral rock from the Austral Islands. The similarity of the decoration on all Marquesan conical pounders seems good evidence that it represents a distinct convention which was in some way linked with the conical form. The best explanation of these facts seems to be that the conical pounders are hybrids which owe their shape, and to a lesser degree the convention employed in their decoration, to a Southeastern Polynesian influence. An alternative explanation is that the conical pounders are archaic and that their carving shows a technique which is more primitive than the historic Marquesan convention.

COMPARISON OF MARQUESAN POUNDERS WITH OTHER POLYNESIAN TYPES

Stone pounders appear to be entirely lacking in Melanesia unless we include under this head certain heavy, bottle-shaped implements used for cracking nuts in the Solomon Islands and some archaeological finds in New Guinea. In Micronesia, stone pounders were used in the Marshall and Caroline Islands but seem to be lacking in the Gilbert Islands. In the Marshall Islands at least, they were used side by side with wooden pounders of identical shape. All the Micronesian pounders appear to be of one type, with some minor variations in the treatment of the upper surface of the head. They have been frequently described and figured.

The pounders of Polynesia must not be confused with the pestles which were found in many parts of Polynesia, but seem to have been unknown in the Marquesas.

Stone pounders do not appear to have been used in Samoa or Tonga but are found everywhere in marginal Polynesia with the possible exception of Easter and Chatham Islands. The New Zealand pounders appear to be pestles rather than true pounders and bear little resemblance to the other Polynesian forms. The absence of broad based pounders in New Zealand is of little significance in a comparative study, for these were specialized implements used principally for crushing breadfruit or taro and would have been of little use there,

but their absence in Western Polynesia is of great interest and would seem to indicate a well marked difference in culture.

If we exclude the curious stirrup pounders from Kauai in the Hawaiian islands and the New Zealand fern root pounders, we find a general similarity among Polynesian implements of this class. There are many minor differences in shape, permitting of the creation of a great number of subtypes, but the major differences appear in the finishing of the upper end or head. On the basis of these differences in head form we may divide the pounders into four types: domed, flat, phallic and transversed gripped. The domed form is characteristic of most Hawaiian pounders and seems to be limited to that group. The flat form appears as a minor type in the Marquesas and possibly in Hawaii, but is lacking elsewhere in Polynesia. It is normal in Micronesia, however. The phallic type is limited to the Marquesas. The transverse grip type is normal throughout Southeastern Polynesia, where it shows many local variations, and occurs as a very rare form in the Marquesas.

The normal Marquesan pounders resemble those from the Society Islands more closely in the form of the base, body and grip than they do those from Hawaii, but their phallic heads are more nearly related to the Hawaiian domed than the Southeastern transverse grip type.

STONE FIGURES

The Marquesans excelled all other Polynesians in the manufacture of stone figures. Although none of their carvings equalled the great Easter Island statues in size, they ranged from large figures over eight feet high to little statuettes scarcely six inches tall. Between these extremes there were all gradations in size. For the sake of convenience the statues will be divided into those which were intended to be permanently set up and those which were portable, only the portable one being considered here. A single object of uncertain significance, which does not belong in either of these classes, will also be described.

A number of small stone figures of fish were used in the *me'ae* of the fishermen. These figures were used one at a time and those not in use were buried within the precincts. The figure in use was placed upon an altar within the main house and was kept there as long as the catches were good. If the luck changed it was removed and replaced by another. According to a different account, which could not be correlated with the above, the small fish figures were the property of ordinary individuals. When the owner went fishing he took the image with him and threw it into the sea, and so great was its mana that on his return he would find it again at a given place, to which it had supernaturally returned.

None of these fish figures were obtained by the expedition and they are rare in collections. Those seen were for the most part of cylindrical or flat oval form, poorly finished and having incised upon one end a rude representation of a fish's head. In one specimen the only feature indicated was the curve of the gill cover. A single very fine specimen in the collection of M. George La Garde of Tahiti has a flat base and high back which slopes upward almost to a point. It is highly polished all over, and bears upon one end a carved head of human or semi-human type.

The small human figures were of two types, single and double. They were used in healing the sick, and also as real votive offerings. They were made by special *tuhuna*, and were carried to the *me'ae* of the god invoked and there left by persons desiring success in any enterprise. (Handy, personal correspondence.)

The single figures show more or less variation, but all appear to fall between the extremes represented by two specimens in the Bishop Museum's collections. Plate LV, *A* shows a short squat figure having a large head with a projecting jaw.

The features are like those of the heads of tiki headed *popoi* pounders of normal type except that the ears are represented as simple knobs. The head is set directly on the shoulders, and the bottom of the jaw is some distance below the level of the top of the shoulders. The arms are thin and unmodeled with short upper and long lower parts, and are shown flexed, with the hands resting upon either side of the body in front. The space between the upper arm and the body is pierced, while the lower arm is carved in high relief and the hand in low relief. The fingers are barely indicated. The back of the figure is concave with a well marked ridge across the shoulders. The breast slopes outward and downward from the head to the level of the hands, and the stomach, between the hands, is shown as a rounded protuberance. The legs are short and are shown in a flexed position, the upper edge of the thighs being parallel to the forearms. The thighs are thin and the buttocks project in the rear as a flange. The lower leg is very heavy, and is separated from the thigh by a horizontal groove which runs across the back and around to the middle of the outer side of either leg. The space between the legs is pierced nearly to the level of the knee. The lower leg tapers slightly toward the foot, which is represented by a thin flange, longest in front. In the middle of the side just above this flange, there is a small knob, probably representing the ankle bone. The sex of this figure is not indicated. A raised band, running from the back of the head to the middle of the shoulders, is pierced with a transverse hole which probably served for the attachment of a cord. The dimensions are: height, 7 inches; maximum width, 4 inches; shoulder width, 3 inches; length of head, $2\frac{1}{2}$ inches; width of head, $2\frac{1}{2}$ inches. The whole surface appears originally to have been polished, even the bottoms of the deepest cuts being rubbed smooth.

It is evident that the maker of this figure possessed remarkable technical skill, and its grotesque proportions can only be explained by the assumption that he was not attempting to represent an actual human being, but to reproduce an established convention. The majority of the small stone figures agree more closely with this specimen, especially in facial type, than with the one about to be described.

Figure *B*, on the same plate is also highly conventionalized, but it appears less grotesque. It is of nearly the same height, but the figure is more slender and the proportions more nearly approach those of the human body.

The head is large and is set directly upon the body, but the mouth is smaller than in *A* and the nose is rather small and naturalistic, with a high bridge. The eyes are shown as long ovals having a raised rim and central ridge, and are connected with the nose by narrow bands. Above each eye there is a raised band whose inner end connects with the base of the nose while the outer end, behind the eye, thickens to form a small ear flange. The arms are carried in the same position as those of *A* and are unmodeled, but the proportions of upper arm and fore-arm are almost natural. The fingers are not indicated. The body is proportionally much longer than that of *A*, its sides are rounded, and the whole treatment is surprisingly naturalistic. The back of the body is nearly straight. Along the middle of the top of the shoulder there is a well marked ridge running from the head to the shoulder tip. From the tip of the shoulder a second ridge slopes downward and forward across the chest, its inner end curving upward abruptly toward the throat. This probably represents the line of the collar bone. A short distance below this line there are two small smoothly rounded protuberances which represent the breasts, while the navel is shown by a small circular pit placed midway between the hands. The sex, male, is indicated by a small conical knob. The short legs are flexed, but the thigh is rounded and the buttocks project to only a natural degree. The lower leg is thick and heavy, and the foot is large. The ankle bone projection is well marked. The back of the head was pierced for suspension by boring two holes, one downward from the top, and the other upward and forward from the bottom.

The convention of the double figure (Pl. LV, C) corresponds approximately to that of the single figures just described.

The two figures are placed back to back and joined at the buttocks and at the shoulders or backs of the heads. The form of the head differs somewhat from that of the other two figures described, and one figure has a hand to the mouth, a pose not uncommon in Marquesan art.

A curious object shown on Plate LV, *D*, which may have been a votive offering or have represented a deity, was found in an old *me'ae*.

This article is a roughly conical piece of cellular lava which appears water worn and shows no signs of working except at the upper end where it has been carved into two heads, set back to back and separated by a groove. The stone is so coarse that it is impossible to determine the convention of the carving. The lower end of the object is smoothly rounded, and but for its size and weight the whole might be taken for a very crude *popoi* pounder. Natives could throw no light on its use.

Stone figures appear to be entirely lacking in Samoa and Tonga, but small figures are found throughout most of marginal Polynesia. They are numerous only in the Marquesas. Fish figures are found in Hawaii, the Marquesas and Society Islands, although there is little information as to their use and significance in Hawaii. Small human figures occur in Hawaii and the Society Islands, but are rare in these localities. The little *kumara* gods of New Zealand are well known and appear to be fairly common. The figures from the different localities seem to conform in every case to the local convention and have little in common.

MISCELLANEOUS TOOLS

Quiros (51) says that the Marquesans used adzes made from thick fish bones or shells. This is the only evidence of the occurrence of these implements in the Marquesas and as no examples are known, it seems probable that Quiros confused the Marquesas with some of the low coral islands visited on the same voyage.

Sharks' teeth, hafted in various ways, were formerly used as knives and carving tools, but no specimens seem to have survived and the methods of hafting have been forgotten by the present natives. According to Langsdorff (38, p. 175) the teeth from the lower jaw of the shark were used as substitutes for gimlets or awls, being fastened to wooden handles. Sharks' teeth, apparently unhafted, were also used as razors. The hair was gathered in small bunches and the tooth sawn back and forth across it at the roots.

Very few bone tools appear to have been used in the Marquesas. Fleurieu (23, p. 135) mentions the use of bone awls. Narrow wedge-like implements of bone or hard wood were used to pound the feather caulking into the bow and stern seams of canoes. Bone knives are described on page 351.

A number of shell implements appear to have been employed in wood carving, although we have no information as to their form. The grooves in *toa* wood tapa beaters are said to have been cut with pearl shells ground to a keen edge, and the handles were shaped with a small black shell, called *mama*. Fleurieu (23, p. 135) says that the Marquesans used "pieces of shell of different shapes and sizes, sharp or toothed like a saw." Knives made from whole pearl shells ground to a sharp edge were used for a number of purposes. There appears to have been no clear distinction between these and the shell scrapers used in tapa making.

Rasps made from the skin of the shark or giant ray were used in shaping clubs and other objects made from the hard *toa* wood. They were made by wrapping the skin around a smooth stick while it was wet and soft. One end of the stick projected a few inches beyond the skin, forming the handle. (See Pl. LVI, A.) Fine shark skin, apparently not mounted, was used in polishing bowls and other wooden objects. Sections from the tail of the giant ray were also used as rasps, requiring no preparation other than drying. These tail rasps have continued in use until modern times for the grating of sandal wood, although recently they have been supplanted by files. The spines of the sting ray are said to have been hafted and used as saws.

Chisels edged with rats' teeth were formerly used by expert Marquesan artisans in the carving of hard stone. None of these implements have survived,

and the method of hafting is problematical. The objects carved with rats' teeth indicate that the work was done by continued rubbing rather than by strokes of the chisel, as the bottoms of the carved lines show a high polish.

The most important wooden tool appears to have been the mallet. This was employed with the chisel in shaping and carving wooden objects, and was also used with caulking tools. Mallets were made of *toa* wood, and were short and heavy. The specimen shown (Pl. LVI, *B*) is 11 inches long, with a maximum width at the head of 4 inches, and a maximum thickness of $1\frac{3}{4}$ inches. The handle of the mallet was round or rectangular and was frequently pierced near the outer end for the attachment of a wrist loop. The head was pear shaped in outline, expanding and thickening gradually toward the outer end. The sides and end of the head were flat, with a surface at right angles to that of the broad surfaces. In use the blow was struck with the broad face, not with the edge.

No specimens of the ancient caulking tools were seen, but those used on the bow and stern seams of canoes are said to have been wedge shaped. Those used for the lashing holes along the sides were simply pointed sticks with a flat upper end. The favorite material for these implements was *toa* wood.

A long needle of hard wood (Pl. LVI, *C*) was used to sew on house thatch and to pass the cord used in canoe lashings through the lashing holes. The specimen collected is slightly over a foot in length. On one side of the point there is a short barb. The butt has a small knob, to which the cord was attached.

The pump drill was the most elaborate of the Marquesan tools. Apparently no examples have been preserved, but their form and method of use are still remembered by the older natives. The Marquesan drills appear to have been identical with those used elsewhere in Polynesia, although there are indications that some of them were equipped with stone whorls, a rare feature. According to informants, drill points were made in ancient times from a sliver of stone, a shark's tooth, or a rat's tooth. All these materials were replaced at a very early date by iron nails obtained from Europeans.

DOMESTIC IMPLEMENTS

This section deals with the artifacts, other than containers, which formed part of the equipment of a Marquesan household. The implements were for the most part used either in the collection or preparation of food.

TOOLS FOR FIRE MAKING

Fire was made in ancient times in the Marquesas by means of the fire plow, a method common to all Polynesia. The fire plow consisted of two parts, the bed and the plow (Pl. LVI, G.)

The favorite material for the bed was a large dry stem of the fruit cluster of the coconut palm which, being fibrous, aided in the collection and retention of dust upon which the success of the operation depended. The second best material was *fau* wood. The bed was not as a rule shaped, but in the better specimens its top was flattened slightly to prevent the plow from slipping during the first few strokes. A little earth was sometimes rubbed on the bed at the beginning of the operation to increase the friction.

The plow was simply a short stick, usually of *fau* wood, sharpened to a straight or slightly convex edge, about one-fourth of an inch wide.

In fire making two men were usually employed, one of whom held the bed firm while the other manipulated the plow (Pl. LVI, H).

The bed was placed upon the ground with the end toward the plowman slightly elevated. The plow was grasped in both hands, forming an angle of about 45 degrees with the bed, and was rubbed rapidly back and forth, care being taken to stop each downward stroke at exactly the same point. As the rubbing continued, a groove was formed in the bed and a small pile of wood dust collected in the lower end of this groove. The speed of the rubbing was gradually increased until both groove and plow were smoking; then, at the right instant, the point of the plow was driven slightly beyond the end of the previous strokes and buried in the dust. A spark was thus kindled and gently blown to a coal, then dumped off into tinder made from tree cotton or shredded coconut fiber. A new groove was made each time fire was to be kindled.

In spite of the introduction of matches practically all adult Marquesans can still make fire by this process, and the time required is surprisingly short. One expert individual repeatedly made fire in between 25 and 30 seconds. The process requires a perfect muscular control which is only acquired with long practise, the trick lying in stopping all the strokes at exactly the same point and lengthening the last only enough to bury the plow in the dust without scattering it.

Native informants insisted that fire was kindled in ancient times by striking sparks from two stones, but it seems probable that this process was borrowed from Europeans at such an early time that its origin has been forgotten. Fire making sets consisting of quartz crystals, a piece of steel, and a section of bamboo filled with tree cotton are still used by the poorer natives.

IMPLEMENTS FOR COLLECTING AND PREPARING BREADFRUIT

Breadfruit is still the Marquesan staple, and utensils for collecting and preparing it form part of the equipment of every family. These utensils may be divided into two classes, those used in collecting and transporting the fruit, and those used in preparing it for food.

NETS AND CARRYING STICKS

Breadfruit nets are of two sorts, small picking nets and large carrying nets. The picking net consists of shaft and head.

The shaft is a long straight pole of some light wood, usually *fau*. The head consists of a net woven on a forked stick, one foot to 18 inches long. The fork is tied to the shaft and is bent backward so that it stands almost at right angles to the shaft. The wood of a tough vine is usually used for the fork, the angle being given by bending the wood while green and tying the prongs back to the shaft until the wood dries. Within the fork, which is six to eight inches long, a small net is woven having a depth of eight inches to one foot. Commercial string is used for these nets, replacing the sennit of former times. The mesh of the net is large and the knot is like an European square knot. In use, the picker is lifted until the fruit is enclosed in the net; the stem is then caught in the angle of the fork and broken by a slight twist. The fruit are usually picked one at a time and transferred from the picking net to the carrying net, which is hung in the trees near the picker. The average carrying net is about 18 inches in diameter and three feet deep. This net (Pl. LVII, *A*) is also usually made of commercial cord, although sennit is still used. The top of the net is held open by a hoop made from a sapling about three-fourths of an inch in diameter, which has been steamed in an earth oven until it is pliable, bent until the ends overlap, and the juncture covered with many laps of cord. The net is suspended from the carrying stick by three ropes of twisted bark, woven together in the center to form a loop, the ends of ropes being tied to the hoop at equal intervals. The bottom of the net is finished with a ring about two inches in diameter made from two strands of sennit. About this ring the bottom strands of the net are passed in closely spaced double half hitches.

Carrying sticks (for transporting the fruit to the house) are simply poles one and a half to two inches in diameter cut from the nearest clump of *fau*. In ancient times, more carefully made carrying sticks are said to have been used; smoothly finished, and with notches at either end protected by a raised flange. No specimens were seen, and it is probable that even then ordinary carrying sticks were nothing more than saplings.

IMPLEMENTS FOR PREPARING BREADFRUIT

The implements used in preparing breadfruit vary according to whether the fruit is to be made into *ma* and stored, or is to be eaten at once. In *ma* making large numbers of the fruit are gathered and piled up to ripen. The ripening is hastened by piercing each fruit at the stem end with a pointed stick (Pl. LVII, *D*) or with a piece of crushed bamboo. When the bamboo is used, it is broken off at the surface each time, leaving a fragment of the bamboo in the fruit.

A special tool (Pl. LVII, C) made from the shell of a cowrie (*Cypraea mauritiana*) is used for peeling the ripened fruit.

An oval hole with sharp edges is ground through the rounded end of the shell. At the opposite end the top is broken away, the base of the shell and a strip across the center being left intact. When in use, the shell is held in the hand transversely, with the base against the palm and the sharp edge toward the outer side of the hand. It is moved downward and away from the body. The peelings cut off by the sharp edge pass through the shell and fall out at the rear aperture like the shavings from a plane. These peelers are remarkably rapid and effective, superior to any European tool for peeling breadfruit.

It is interesting that an identical tool is used in Kuschai, in the Carolines, although it is not reported from other parts of Micronesia. It is impossible to outline the Polynesian distribution of this tool. It was used in the Society Islands, but not in Hawaii, and seems to be absent in Tonga.

When properly ripe, the breadfruit are soft enough for the raw pulp to be easily separated from the core with the fingers. Slightly unripe fruits are sometimes cut up for *ma* making. In ancient times this was probably done with a wooden breadfruit splitter. An implement of this sort in the Bishop Museum is eight inches long, with a maximum width of four inches. (See Pl. LVII, B.) It has a long oval blade terminating in a broad flat knob. Only the outer end of the blade is sharpened. It is made of some rather hard, light weight wood.

Fresh breadfruit are roasted on an open fire, the proper moment for removing them being determined by the sound they give when tapped with a stick. They are lifted from the fire with two sticks, or, in well equipped households, with tongs.

These tongs are made from a single straight piece of wood, preferably *mio*, about 2½ inches in diameter and 3 to 4 feet long. The wood is split for the lower two-thirds of its length and the ends spread apart. A few turns of *fau* bark are usually tied around the upper part of the stick to keep it from splitting in two. Tongs of this sort are also used to arrange the hot stones used in the earth oven, or *umu*.

The charred outer surface of the breadfruit is removed with a knife of wood or bone. Most of the wooden knives appear to have been simple sticks with one end fashioned into a thin blade. Any wood, even that of the *fau*, might be used. (See Pl. LVII, E.) The bone knives are more carefully made (Pl. LVII, F.) As all those seen were shaped from the leg bones of cattle it seems doubtful that the type is an ancient one.

The upper end is squared and rubbed smooth, the natural swell of the bone at the joint giving the handle a slightly expanded butt. The blade is formed by grinding away one side of the shaft. The average knife is 9 inches long, with a blade length of 4 inches. The blade is 1½ inches wide at the base, tapering toward a broad rounded point.

After peeling, the breadfruit is dropped into the *popoi* trough, cored, and beaten into a paste with the *popoi* pounder.

The *popoi* trough is usually made from breadfruit wood. An average specimen is 5 feet long and 16 inches wide, with square ends, straight sides, and a rounded lower and slightly excavated upper surface. In new specimens the depth of the hollow rarely exceeds $1\frac{1}{2}$ inches but in old specimens it may be as much as 3 inches deep in the center, due to wear. In one very old *popoi* trough, evidently made with stone tools, the interior had been hollowed with fire. The dimensions of individual *popoi* troughs vary considerably, but those used in Nuku Hiva are on the whole shorter and broader than those used in the southern islands.

IMPLEMENTS FOR PREPARING COCONUTS

Coconuts rank next to breadfruit in the Marquesan dietary, but they seem to have been somewhat less important in pre-European times. They are gathered by hand, without special appliances. The first step in their preparation is to remove the thick husk. This is done by means of a pointed stake, about two inches in diameter, which is fixed rigidly in the ground, point up. To husk the nut it is grasped in both hands, struck sharply upon the point of the stake, and twisted away from it, removing a sliver of the husk, the process being repeated until only the inner shell remains. The process appears easy, but it calls for a considerable skill in manipulation. Nuts are usually husked where gathered, to avoid carrying unnecessary weight.

Nuts other than the thinnest shelled drinking nuts are opened by a few sharp blows of a stone given along the line of greatest diameter, an expert being able to break a nut into two almost equal halves in this way. The water in the cavity of old nuts is thrown away, and the flesh itself, rarely eaten, is grated to extract the milk. Coconut graters vary considerably in the details of form, but are all made upon a single principle.

The graters consist of a stool, or seat of some sort, from one end of which an arm projects more or less horizontally. At the end of the arm the actual scraper is fastened. In ancient times this consisted of a piece of rough coral, or of a strip of shell with the upper edge cut into teeth. Much care is expended upon the seat portion of some of these scrapers, which appears the more remarkable as the furniture of a Marquesan home rarely includes stools or other raised seats. To use the scraper the workman places himself astride the seat, and rubs the nut rapidly over the end of the arm, with a downward and outward motion. A bowl placed below catches the fragments of meat as they fall. When a sufficient quantity of the grated meat has collected, water is added and the whole mixed to a paste.

A strainer is then brought into play to separate the milk from the meat.

This strainer is nothing more than a thick bundle of fiber, about one foot in length and two to three inches in diameter, which is spread out and drawn across the bowl toward the workman, gathering up part of the paste. The ends of the strainer are then twisted in opposite directions, enclosing the paste, and the whole lifted from the bowl and wrung out, the liquid expressed falling back in the bowl. The dry meat remaining in the strainer is thrown away and the process repeated until only a thick creamy white fluid remains in the bowl. Two species of fiber are used for strainers, the commoner is that from the husk of the coconut. The finer strainers are made from the fibers of the stem of a long-leaves plant, which in leaf form and habit of growth resembles large garlic, and from a reference in Jardin (33) is probably *Cyperus macroilema*. No attempt is made to separate the fiber from the substance, the stems are simply split into long strips. (This fiber is also commonly employed for kava strainers, but there is a con-

ventional difference in the method of straining the two substances, kava being squeezed with one hand only while coconut milk is wrung out with both hands.)

Copra, the dried kernel of the coconut, although not a food, plays an important part in Marquesan domestic economy. The old method of copra making was as follows:

The ripe nuts were husked and broken into two equal halves by the methods just described. These halves were tied together, back to back, by wisps of the husk left attached to them for the purpose. They were then hung up high enough to be out of the reach of pigs and left until the kernel was partly dry and had begun to separate from the shell. The meat was then removed with a special tool made of *toa* wood.

These tools (Pl. LVI, *D*) have a smoothly tapering handle whose outer end is pointed, and a flat or slightly concave blade which curves upward toward its tip. In length they range from 10 to 14 inches and in blade width from $1\frac{1}{2}$ to $2\frac{1}{4}$ inches. In modern copra making these wooden knives have been largely replaced by tools having an iron blade of somewhat similar form.

Tree cotton appears to have been introduced into the Marquesas in post-European times and the appliance used to separate the fiber of this tree from the seeds is probably an introduction (Pl. LVI, *F*). There is some uncertainty on this point, however, and it seems well to describe the tool as though it were a Marquesan invention.

The instrument consists of a straight piece of *fau* wood about 20 inches long and $\frac{5}{8}$ of an inch in diameter whose lower end is split into four equal parts. Two slivers of bamboo, each about four inches long, are placed in the splits at right angles to each other about two inches above the tip of the shaft and lashed with thin string. The tips of the bamboo and of the splints of the shaft are sharply pointed. To use the implement the lower end is placed in a mass of mixed fiber and seeds and the shaft twirled rapidly back and forth between the palms until a mass of fiber has collected around the points. This clear fiber is then removed and the process repeated until only the seeds remain. It should be remarked that the seeds of tree cotton are not covered with lint and separate from the fiber much more readily than the seeds of the commercial cotton.

MISCELLANEOUS DOMESTIC IMPLEMENTS

Digging sticks were employed in agriculture, also in digging earth ovens and *ma* pits. They appear to have been simply poles four to five feet long made of some hard wood, *toa*, *kookuu*, and *piapiiau* being the species preferred. The shaft was about three inches in diameter and was sharpened at the lower end into a broad flat edge. In view of the close resemblance between Marquesan stilt steps and the foot rests of Maori digging sticks, it seems rather curious that the Marquesans never hit upon this simple improvement. Digging sticks are no longer used in the group, and no information was obtained as to their exact method of use.

Before the introduction of iron, bamboo knives were used for cutting a variety of soft non-fibrous substances. These knives are now obsolete and no specimens were collected.

According to the accounts of informants the bamboo knives were slivers, one-half to three-quarters of an inch in width, from the stalk of the smaller of the two native species of bamboo. When first split off, the outer coat of the stem gives a surprisingly sharp edge, but this soon becomes dull with use. When a knife became dull it was usually thrown away and another sliver selected; but it was occasionally sharpened by tearing a thin strip off the edge with the teeth. Jardin (33, p. 53) says that knives made from this bamboo were used to dispatch human victims for sacrifice.

Knives made from sharpened pearl shells were used, also stone knives made from long flakes.

On the rare occasions when an indoor light is required the natives use candles made of *ama* nuts. The ripe nuts are baked in an earth oven, the shells cracked, and the oily kernels extracted whole. These kernels are then strung on the stiff midrib of a coconut leaflet, the lower end of the midrib being left bare for some inches to serve as a base, or handle. As far as can be learned no special candle holder is used. The lower end of the midrib is simply thrust between two stones of the paved house floor. When ignited, the kernels burn slowly, with a flickering smoky flame and the light requires constant tending, as it is necessary to knock off the cinder of each nut with a short stick as soon as the fire had passed to the one below. It is rather curious that lamps appear never to have been used by the natives in the Marquesas, although their use was common in both the Society Islands and Hawaii. Torches were rarely used for interior illumination, but are still extensively used in night fishing. (See p. 397.)

CONTAINERS

The Marquesans use a great variety of containers which may be divided into two main classes: natural containers, such as bamboos, coconut shells and gourds, which need little preparation for use; and wooden containers, which require considerable skill in manufacture. The wooden containers are by far the more important in the Marquesas and are well represented in most museum collections.

NATURAL CONTAINERS

JOINTS OF BAMBOO

The Marquesans, like all peoples living in regions where the larger species of bamboo grow, used joints of bamboo to transport and store fluids. Small bottles, made from a single joint, do not appear to have been used, as their place was taken by more convenient utensils of gourd or coconut shell. Large bottles were made by cutting bamboo shoots three inches or more in diameter into sections from 10 to 20 feet long and piercing the septa between the joints, forming a pipe closed at one end. The piercing is now done with an iron rod heated red; the ancient method could not be ascertained. When in use the upper end of the tube was filled with a plug of green leaves. Bamboo bottles were purely utilitarian and were never decorated.

COCONUT SHELLS

The climate and soil of the Marquesas are ideally adapted for the growth of coconuts, the trees bearing profusely and producing nuts of remarkable size. It is not surprising, therefore, that the natives made an extensive use of coconut shells as containers and that they developed considerable skill in the manufacture and decoration of utensils of this kind.

The half shell of a coconut constituted a natural cup which could be used without preparation. The first improvements upon this original form appear to have been the smoothing of the edge by grinding and the removal, also by grinding, of the small external point which prevented the cup from standing upright. Cups and bowls made in this way are still occasionally used. The next step is to remove the tough inner skin and rub the outer surface smooth; rubbing-stones and burnishers are used for this work. As a final improvement the cups were either carved or ground thin. Carved cups were given a smooth finish and then decorated by the same methods and with the same designs as wooden containers. To make the thin, uncarved cups both the outer and inner surfaces were ground away until the walls were only slightly thicker than egg shell china. They were then thoroughly impregnated with oil, making them elastic and capable of withstanding quite heavy usage. When first finished, the surfaces of coconut

cups were rather dull, but with handling they acquired a beautiful glossy polish. Many cups were provided with a cord handle by which they were hung up when not in use. This handle consisted of a loop of sennit passed through a hole a short distance below the rim, the inner end being kept from slipping back either by a knot or by a small disk of pearl shell, like a button. (See Pl. LVIII, *A*, 1.) The finer grade of cups were used principally in kava drinking, which gave the inner surface of the cup a coating of glossy yellow enamel, like lacquer.

It is difficult to draw any line between cups proper and bowls, as the two classes grade imperceptibly into each other. As a rule the bowls are larger and thicker walled, and most specimens have recurved rims, that is, they are made from more than half a nut. Most of these bowls are provided with handles by which they can be suspended horizontally. One specimen in the Bishop Museum has the handle cut in one piece with the body of the bowl (Pl. LVIII, *A*, 2), but as the bowl is evidently unused it seems doubtful whether this is an ancient form. The handles of old specimens are of cord and appear to conform to a single type. (See Pl. LVIII, *A*, 3.) They were made as follows:

A pair of holes were pierced through either side of the shell a short distance below the rim. A loop of sennit cord was passed through each pair of holes, the ends protruding on the outside. A large black seed was then threaded upon each end of the loop and pushed down against the outer surface of the utensil. A cylinder of human bone, carved with horizontal grooves, was next threaded on, followed by another seed. The two strands of cord were then brought together and passed through a short thick ornament cut from the shaft of a human humerus, carved into a tiki figure. Above this ornament both strands were threaded through a single black seed and closely wrapped with a strand of fine sennit, giving them the appearance of a single cord. The ends of the loops were either tied together above the center of the bowl or interwoven and enclosed in a continuous wrapping which concealed the point of juncture. Bowls arranged for suspension in this way were frequently provided with carved wooden covers like those used for gourds. Bowls were usually rougher in finish than cups and were rarely carved.

Coconut bottles were made from the whole nut, the kernel was removed by a simple but ingenious method. (See Pl. LVIII, *C*.)

A large ripe nut was husked and the shell around the largest eye ground away to form an aperture about one inch in diameter. The nut was then placed in some stream where fresh water shrimps were plentiful and was left for a few days. The shrimps, entering through the aperture, picked the interior of the shell clean and left it ready for use. One of the smaller eyes was then pierced with a pointed stick and a loop of heavy cord passed through and secured on the inside, the outer end of the loop serving as a handle for the bottle. A wooden stopper for the large aperture completed the utensil, which appears never to have been decorated.

A slightly different type of bottle was used for the storage of scented oil for the hair (Pl. LVIII, *B*).

These utensils were made from small, thick shelled nuts having a more or less pointed stem end, which was ground off to below the eyes. The kernel was removed by the method just described. Most bottles of this sort were elaborately carved, some of the specimens ranking among the finest products of the native art.

GOURDS

The Marquesans appear to have made a rather limited use of gourd containers. No gourd plants were seen growing, but from a comparison of the utensils collected with those in the Bishop Museum the species was probably *Lagenaria vulgaris*. According to informants, both necked bottles and neckless containers were formerly used, but all the specimens seen were neckless and were called by the natives *hue*. To make a *hue* the ripe gourd was plucked from the vine while still soft and the stem and adjacent shell cut away to form a round aperture three inches or more in diameter. The seeds and pulp were emptied out and the shell carefully dried in the shade. The interior was then scoured smooth with beach sand. Utensils of this sort appear never to have been decorated and ornamental shapes made by deforming the growing fruit had never been heard of by the informants questioned. All the *hue* seen were comparatively small, the largest being slightly under one foot in diameter, but the size of some of the wooden *hue* tops seen in burial caves would indicate that much larger utensils of this sort were formerly used. (See Pl. LVIII, E).

When in use the *hue* was supported and protected by a network of cords similar in principle to the Hawaiian *koko* (net), but rather inferior in design and execution. The manufacture of these nets has been discontinued and only two specimens were seen in the group, both in Pua Ma'u, Hiva Oa. Both were made of coconut fiber cord. Ordinary sennit of the sort used for house lashings was used for one specimen, and for the other, a flat five strand plait. The form of the nets may be seen from the accompanying sketches. For *hue* No. 1, on Plate LVIII, E, the process of manufacture appears to have been as follows:

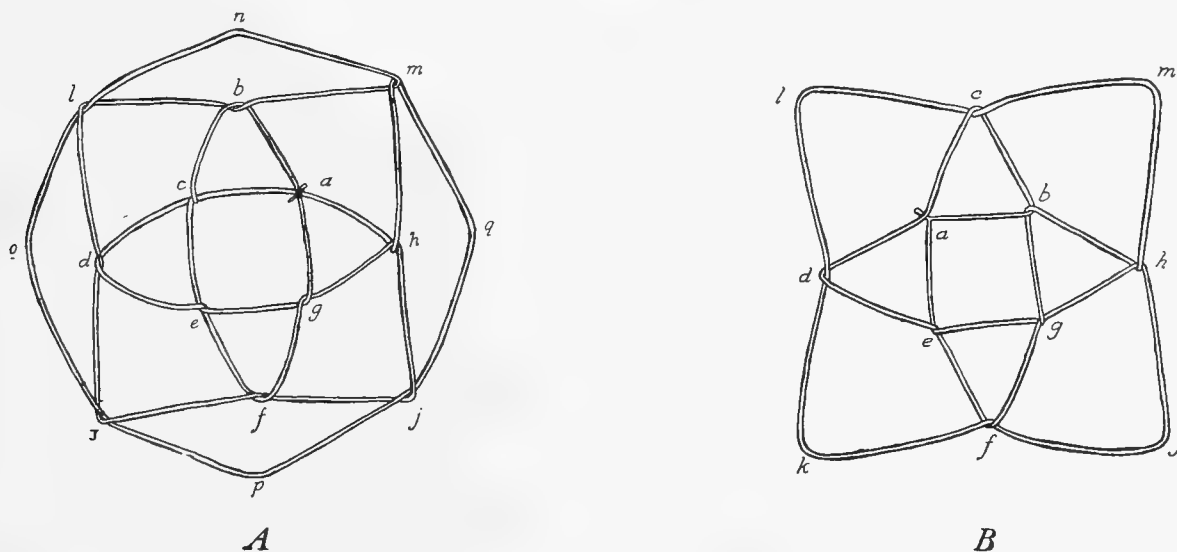


FIGURE 7.—Sketches of network of cords used to support gourd containers.

A large loop was first formed, one end of the cord being tied and left at *A*. (See fig. 7, *A*.) The loops *abc*, *cde*, and *efg* were then made in the order named. The direction was then reversed and the loops *ghjf*, *fk d*, and *dlb* formed. The direction was then again reversed and the loops *bmnl*, *lok*, *k p j*, and *jgm* made. From *m* the cord was carried to *h* and thence to *a*, where it was knotted in beside its other end. The points *n*, *o*, *p* and *q* projected above the top of the *huc* and served for suspension. The dimensions of the different meshes are: *a* to *c*, $4\frac{1}{2}$ inches; *a* to *b*, $4\frac{1}{2}$ inches; *b* to *l*, $6\frac{1}{4}$ inches; *l* to *n*, 5 inches. The mesh, with the exception of the outermost loops, is drawn to scale. The knot employed is uniform except at the points *h* and *a*. It is a complicated wrap knot for which no name is known.

The net of *hue* No. 2 on the same plate, although superficially resembling that of *hue* No. 1, is made on an entirely different principle. (See fig. 7, *B*.)

The netting was not begun with a ring, the course of the cord being *a*, *b*, *c*, *a*, *d*, *e*, *f*, *g*, *h*, *j*, *f*, *k*, *d*, *l*, *c*, *l*, *h*, *b*, *g*, *e*, to *a*. Here the two ends are spliced together into a single cord of the size used throughout and tied about the line *cd*. A loop of cord was passed through the outermost meshes at *l*, *m*, *k* and *j*, to serve as a handle, its ends being tied together in a heavy knot. The mesh sizes are: *a* to *b*, $4\frac{1}{4}$ inches; *a* to *d*, 5 inches; *d* to *l*, $7\frac{1}{2}$ inches. Two types of wrapped knots were used in different parts of the net.

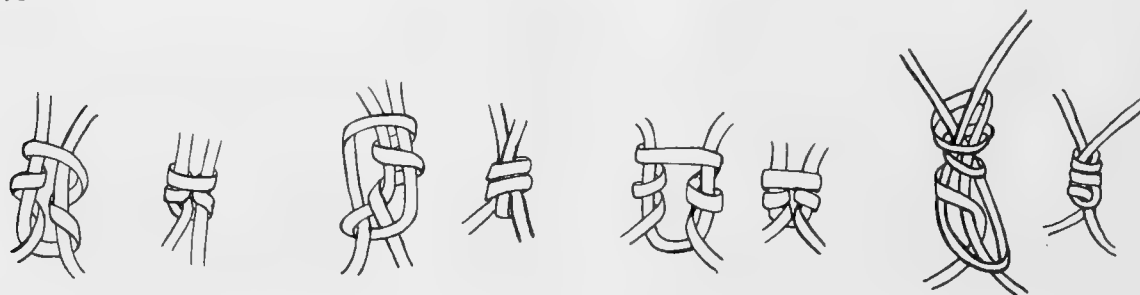


FIGURE 8.—Sketches of knots used in nets for gourd containers.

The widely divergent technique of the two specimens would seem to indicate a considerable variety for these objects in ancient times.

Gourd *hue* were normally provided with wooden covers, which were all made according to a fixed pattern. To one ignorant of its use such a cover would appear to be a small squat broad mouthed jar, with a rounded bottom, flatly convex to hemispherical body, a short neck whose sides sloped inward slightly toward the top, and a wide flat shoulder whose upper surface sloped inward and downward to the base of the neck. When used as a cover, the jar was inverted, the neck fitting into the orifice of the *hue*, the shoulder resting upon its top. The body of the cover rose above the *hue* as a small dome, and was frequently carved, the decoration consisting of two tiki faces placed opposite each other. The space above and between these faces was filled with shallow parallel grooves running continuously from edge to edge. In spite of their form, *hue* tops appear never to have been used as separate containers, and they were probably hollowed only for the sake of lightness. (See Pl. LVIII, *F*.)

WOODEN CONTAINERS

The Marquesans made a great variety of wooden containers all of which may be placed in one or the other of two main groups: boxes, and bowls or dishes. The objects of each of these classes show considerable individual variation, and in the case of covered containers it is often difficult to say whether a given specimen is a bowl or a box.

BOXES

Wooden boxes, used for the storage of valuables, formed part of the equipment of every well-to-do Marquesan family. Such boxes were hewn from large pieces of wood by the processes described under bowl manufacture. (See p. 360.) The favorite materials were breadfruit, *temanu* and *mio*. The boxes varied greatly in size and in minor details of form and decoration, but all the specimens seen were clearly of a single type. They were made in two parts, a body and a lid. (See Pl. LIX, A.)

The body was oval in outline, with a more or less rounded bottom and considerably recurved sides; the upper edge was finished in a narrow flat rim which was broadened at either end. At one end of the body a large knob projected above the rim, while at the opposite end the body was either flattened or bore a short flat-ended horizontal projection. The lid was rounded on the outside, excavated inside, and bore along the inner edge of its rim a thin downward projecting flange which accurately fitted the orifice of the body. The end which rested against the knob of the body when the lid was in position was either flat or notched. The opposite end was elongated and provided on the under side with a short downward projection like a thick blunt hook, which rested against the outside of the body.

In one specimen, which differs in other details from the normal type, the rear end of the lid bears an upward projection corresponding to the knob of the body. (See Pl. LIX, B.) In well made boxes the lid fits the body so closely that it is frequently difficult to remove it. The whole utensil appears to be a more or less modified bird form, the body knob representing the head; the horizontal projection of the lid, the tail. (See Pl. LIX, C.) Boxes were frequently carved and the designs were usually the same as those used upon bowls. The first step apparently was to carve the body knob into a tiki face, and specimens in which this constitutes the sole decoration are not uncommon, although the more ornate examples are carved all over. In one crudely carved specimen in the Bishop Museum the designs show a preponderance of angular-geometric figures coupled with small line representations of human beings which are not of tiki type. (See Pl. LIX, B.)

BOWLS AND DISHES

Wooden bowls and dishes are probably more numerous in ethnological collections than any other objects of Marquesan manufacture, as the elaborate carvings with which many of them are decorated make them eagerly sought after by collectors. They still form part of the equipment of every native household

and are manufactured in considerable numbers. No lathes have ever been introduced into the Marquesas, and all wooden utensils are still made by aboriginal processes modified only by the introduction of metal tools. The modern makers have ceased to reproduce the more elaborate ancient forms and ordinary utensils are rarely carved at the present time; but skillful carvers are still found in Nuka Hiva and Hiva Oa, and especially in Fatu Hiva, which was formerly the artistic center of the group.

The Marquesans employed a great variety of woods for their utensils, the favorite being *mio* (*Thespesia populnea*). This tree has a dark brown heart wood and white sap wood, while its softness and even texture make it especially easy to carve. Next in importance came the *temanu*. This wood is light red to yellow in color and somewhat harder and less even grained than the *mio*, but still well adapted to the purpose. The trees attain a very large size, and on this account *temanu* appears always to have been used in ancient times for feast bowls and other large vessels. Most modern utensils are made of this wood, as the supply of large *mio* is practically exhausted. *Mei* (breadfruit) was used to a limited extent, but was considered an inferior material. *Fau* wood, when taken from old trees, was occasionally used, and small more or less ornamental vessels were made from sandal wood or *toa*. *Toa* was especially difficult to work on account of its hardness and its tendency to split, and objects made from it seem to have been primarily intended to show the skill of the workman. A number of other woods were sometimes used for special purposes or in the absence of better material, but according to informants, *vai*, a close grained red wood which appears well adapted to bowl making, was never used because it would split when exposed to the sun.

Modern bowl makers shape their utensils with adzes and knives, but knives are little used. The adzes are provided with iron blades made either from plane irons or from sections of iron pipe, which has replaced the stone blades of the *toki kouma* type. (See p. 323.)

A well equipped workman employs a whole series of adzes of diminishing size, the last used being miniatures only a few inches in length. Green wood is used when possible, as it is softer and easier to work, but seasoned wood can also be used for bowls after it has been soaked in the river for several weeks. A block considerably larger than the intended object is first roughed out from the log, and is then worked down with the adz until the desired outline has been obtained. In all the examples seen approximately the final form was given to the exterior before the excavation of the interior was begun. In making round bowls a pair of European compasses are now used to outline the rim, but the shaping of the body is done entirely by eye. In shaping the exterior a light glancing blow is used, the chips detached being of such uniform size that a well made bowl just prior to polishing is covered with a multitude of small regular facets like those on a bowl of beaten brass. In excavating the interior the workman begins at the center, and gradually works back to the edges, hollowing the whole interior to the depth of about an inch. He then begins at the center once more and excavates another level, continuing until the desired depth is reached. The inside of an unfinished bowl

thus consists of a series of steps, each marking one of the layers of excavation, and the removal of these steps is the last process prior to the polishing. The workman usually sits upon the ground, with the bowl held on edge in front of him and steadied with the left hand. In hollowing the interior a double stroke is used for each chip, the first blow being made horizontally, the second vertically. The bowl is slightly turned after each double stroke, and the excavation kept as nearly circular as possible. A knife is ordinarily used to trim the rim, being held with the blade below the hand, edge outward, and pushed away from the operator. Bowls are shaped as far as possible with the adz and knife, the final polishing serving only to obliterate the tool marks. Polishing is done with sand paper, the finest grade obtainable being used for the last stage, but in ancient times coral grinding stones were used. When the bowl has been rubbed smooth the surface is burnished with a china door knob, applied with as much pressure as possible. Old pebble polishers which have acquired a glassy finish are still occasionally used. The modern workman seems to be fully as skillful as his poorly equipped ancestor, and unless some enterprising European introduces lathes into the group it seems probable that the primitive processes of manufacture will survive unchanged for many years.

The Marquesans relied almost entirely upon carving for ornamental effect, and from conversations with modern bowl makers and carvers it would seem that the natives have little appreciation of the beauty of the wood used or the aesthetic value of pure form. This is borne out by the fact that some elaborately carved specimens are noticeably asymmetrical, when the fault could have been remedied without injury to the utensil. It is certain that many shapes of utensils were formerly used, but the long European contact has resulted in the disappearance of many of these original types and probably in the introduction of new types. The following list of native terms for various types of bowls and dishes has been compiled by Handy from Dordillon's Dictionary:

- Kotipu. A large oblong dish (pig white in the middle and black at the extremities).
- Kotihu. Dish.
- Kopuha. Kind of native dish.
- Kokomo. Cover of calabash, operculum of shell.
- Kokipo. Covered vase for popoi.
- Kiopo. Native dish. Bowl.
- Kipo. Vase to serve kava. Popoi bowl with cover.
- Kepo. Vase for kava.
- Kaipu. All vases.
- Ipu. Bowl. All vases of small dimensions.
- Hue. All vases with large openings.
- Hue maoi. Calabash.
- Tipeni. Dish.
- Tihara, Tiharahare. Small dish.
- Tiaha. Drinking vase.
- Tanoa. Vase to prepare kava.
- Tahake. Small dish.
- Tahae. Oblong dish.
- Tahaha. Large dish for popoi.
- Puru hue. Small dish.
- Pihare, Piarehare. Native dish.
- Papa kotue. Covered dish for popoi.
- Maae tapu. Large vase with cover to conserve popoi.
- Akuipoi. A round wooden dish. An oval dish with a cover.

Many of these container forms could no longer be identified, and the following descriptions are based on specimens seen or described by reliable informants.

Round wooden bowls (Pl. LIX, F) are still in use in all native households. The larger bowls are called *pōra*, the smaller *ipo* or *tahake*.

In bowls of ordinary sizes the form is that of a segment of a sphere, but this is somewhat modified in the case of the large feast bowls, which are rarely over nine inches deep, although they may have a diameter of over four feet. Flat bottoms, meeting the sides at an angle, appear to be unknown. In most large and many small specimens the sides have a slight external recurve at the rim, and in practically all round bowls the greatest width of the interior is a short distance below the rim. The rims are flat and relatively wide, meeting the inner and outer surfaces of the body at sharp angles. In most bowls the rim is horizontal, but in some the inner edge is considerably higher than the outer.

At least two types of very deep circular bowls were used in ancient times. One of these, called *kipō*, was used on the island of Nuku Hiva for *kava*. It was about ten inches tall and eight inches in diameter, and is said to have been provided with a small flat base (Handy, personal correspondence). In Hiva Oa a large, very deep bowl of *toa* or *mio* wood was sometimes used in the burial caves as a container for the skull of a chief or beloved relative. The practice was rare, however, and the description is based upon a single specimen found some years ago in a burial place. The original bowl was not seen as its finder had used it as a container for his wife's skull, but according to natives who had handled it, it was elaborately carved and had the form of the deep Hawaiian *umeke* (8, a, p. 161 and fig. 142).

A description of a special type of small circular container, called *hue pō'o* was obtained in Pua Ma'u, Hiva Oa, by Handy.

This container was provided with a lid having a knob handle in which there was a cavity much like the sponge container of a modern humidor. Human flesh was packed into the cavity, and as it decayed the juice dripped down into the bowl below. The fluid was wiped out from time to time with green taro leaves and eaten as a delicacy. The object of the peculiar handle arrangement is said to have been to guard against the theft of the flesh. The container was provided with a long loop handle, probably like those used on coconut bowls, and was carried slung around the neck.

Many circular bowls were provided with fiber handles which were attached to one side and served for the suspension of the utensil when not in use. The simplest of these handles consisted of a loop of sennit passed through a hole below the rim of the bowl and held by a knot on the inside. In another simple form two holes were drilled, the loop being passed through both. The most characteristic handle attachment, which is still used on most well made bowls (Pl. LIX, D) is made as follows:

A hole is bored in the side of the vessel a short distance below the rim, care being taken not to pierce the inner wall. A second hole is then bored downward through the rim, meeting the first at right angles. A loop of cord, braided continuously or spliced at the ends, is then inserted in the lateral hole and fastened by a wooden plug driven downward through the vertical hole. The top of the plug is cut off flush with the rim. Handles of this sort were sometimes decorated by stringing upon the loop large seeds or pieces of carved bone.

One specimen was described as having a very short loop of cord passed through a large ring of carved bone, which served for suspension. In very large feast bowls the handle was made of a heavy plaited cord of coconut fiber whose ends were attached at two points, four to five inches apart. Such handles were usually encased in a series of bone tubes, made from the small bones of the lower arm or leg. These were similar to the tubes used on the cord handles of coconut shell bowls. The native name of these tubes was not ascertained but according to Handy (32) Dordillon gives a term, *vipoo*, which he defines as "a piece of bone to ornament dishes or drums." It seems probable that this refers to the small carved figures rather than the simple corrugated rings, for the rings were not used on drums so far as could be learned. It is rather interesting that the large feast bowls had handles on the side only, indicating that the handles were used to suspend or drag them, not to carry them.

Wooden handles, cut in one piece with the bowl, are very rare in the circular forms—only three examples were found.

In one of these specimens there are four small, equally spaced projections a short distance below the rim. These projections are carved into peculiar little double figures, and as the rest of the bowl is uncarved the projections are probably intended for ornament, although they could have been used for handles.

Another bowl seen in a native household, had a flat handle about six inches long projecting from one side of the rim. The shape of this handle was identical with that of an ordinary American frying pan, and it seems probable that this development was due to European influence. Still another bowl (Pl. LIX, E) now in the Bishop Museum, is egg shaped rather than round.

It is a rather deep well-made bowl, 9 inches wide and $10\frac{1}{2}$ inches long to the base of the handle. The handle springs from one side of the rim and is $3\frac{1}{8}$ inches long and an inch wide in the center. The outer end is expanded both laterally and vertically, and the tip has a deep vertical notch. The whole handle has very much the shape of the distal end of a human humerus, and may very well have been modeled after one.

It seems probable that covers were employed with some types of round bowl other than the *hue po'o* just described, but if so their use has been discontinued for many years and no examples have been preserved or described.

Some round bowls, especially those of recent manufacture, are provided with low circular bases. A similar feature is found in certain tureen-like oval forms (p. 365). Most of the natives believe that this feature is a recent innovation, copied from the Chinese rice bowls introduced by European traders. On the other hand, a very beautifully carved bowl in the possession of Mme. Mallius, of Ta'aoa, Hiva Oa, shows this feature, although it is obviously an old specimen. It seems probable, therefore, that if the circular base is non-Marquesan it was introduced during the early period of contact.

The transition from round bowls to the oval and rectangular forms appears to be a gradual one, every step being represented by a few examples. No. 1 shown on Plate LX, A, is especially interesting in this connection as it has all the features of an ordinary round bowl except that the rim is slightly flattened on

all four sides. Square utensils appear to have been unknown, those which were not round being oval or oblong. In most of the oblong specimens the sides are more or less convex, the difference between them and the oval forms lying in the degree of flattening at the ends.

Two specimens of a very curious oblong type not observed elsewhere were seen in the Valley of Hanapaoa, Hiva Oa. These utensils were flat bottomed, with shallowly convex sides and ends which met in well marked angles. The whole form bore a remarkable resemblance to the type of food dish commonest among the Haida of the Northwest Coast of North America. The utensils were evidently of recent manufacture and the natives could give no name for the type and were uncertain whether it was ancient.

Oblong trays and dishes appear to have been in rather common use in ancient times, although few specimens have survived. Those seen were provided with low vertical sides and almost flat interior bottoms. The exterior was smoothly rounded. The troughs for beating *popoi* are really very large oblong trays (p. 352).

Several well marked types of oval dishes may be distinguished, of which the long narrow flat ended containers, called *toto*, are the most important. Except for the proportions of the different parts and the inward curve of the sides toward the rim, the form of these utensils is almost identical with that of the underbodies of the large built up canoes. The ends of the vessel are straight, the sides convex, so that the greatest width is in the center. The sides also show a vertical convexity, and the maximum width of the utensil both internally and externally is about midway between the bottom and rim. (See Pl. LX, B.)

Most of the *toto* are large. Bowls long enough for a man to lie in are remembered by the older natives. The smallest example seen was 18 inches long, with a maximum central width of $8\frac{5}{8}$ inches. Usually no handles were used with this type, but this small specimen was provided with a handle consisting of two loops of sennit passed through holes bored vertically in the corners and tied together above the center.

Toto are said to have been used principally for the transportation of prepared food at the time of feasts, and according to natives their shape was designed to make them easier to carry upon the shoulders. They were carried transversely, resting upon both shoulders and the nape of the neck, the bearer's head being bowed upon his chest.

Small oval *kava* bowls, with nearly parallel sides and rounded or pointed ends appear to have been fairly common and probably constitute a distinct type. Some of these bowls were provided with a suspension loop or handle attached to the center of one side. (See Pl. LX, A, 2-3.)

Oval dishes and trays are now obsolete, but seem formerly to have been rather common. They were of all sizes; examples as much as five feet in length are remembered. Smoothly rounded inside and out, they had no distinct sides. Some specimens showed a distinct flat rim. In a large specimen of this type in the Bishop Museum one end of the rim bears a short upward projection cut into two levels, like steps, but as no examples of this were seen in the group its purpose was not ascertained. (See Pl. LX, C.)

Stewart (59, pp. 331-332) speaks of a large trough "rudely sculptured at one end into a head gaping hideously, as if to devour all who approach," which he saw in a *me'ae* of Nuka Hiva. At the time of his visit it contained a decaying human sacrifice. Very large oval bowls with tight fitting covers are also mentioned by early visitors, but no examples appear to have survived.

Small oval bowls having at one end a projecting neck terminating in a knob, and at the other a flat tipped projecting tail flush with the rim, appear to have been rather common in ancient times. In one specimen of this type (Pl. LXI, B, 1) which was found in a burial cave and is probably pre-European, the knob is carved into a fine tiki head, directed forward and slightly upward, and the lower side of the neck is encircled by a row of small perforations which were probably intended for the attachment of hair or feather ornaments. In another specimen (No. 2 in the same illustration), also old, the outer end of the knob is pointed and its upper surface is carved into a legless tiki whose face is nearly horizontal. This specimen has on either side a short distance below the rim, a horizontal flange, the whole form being obviously a modification of a bird effigy. Two holes for the attachment of cords are drilled near the tips of the knob and of the tail. The relation between the bowls of this type and the bodies of the boxes (p. 359) is evident, and it is difficult to determine to which class some specimens belong.

The collections of the American Museum of Natural History, New York City, contain an elaborately carved bowl having at either end a flat projecting handle. A similar specimen with the handles carved into grotesque heads is figured by Christian (10, p. 148). Both specimens are obviously recent work, probably made for sale. There is no reason to suppose, however, that they were copied from any European form, a point of importance in our consideration of the next type.

Marquesan utensils having an oval body, a low round base placed centrally, and a projecting knob handle at either end, are quite common in collections (Pl. LXI, A). They are frequently provided with a domed cover having upon its center a knob handle, and are always elaborately carved. The resemblance of many of these utensils to European soup tureens is striking, and old

European residents of the group and many natives believe that they were copied from them. Other natives declare that the form is ancient. In view of the containers mentioned in the preceding paragraph it seems most probable that this type has been developed from an aboriginal one by the addition of a base and that the obvious resemblance of the resulting utensil to a soup tureen has given rise to the belief that the European utensil was copied entire. The question of the occurrence or non-occurrence of a base in primitive Marquesan utensils is of considerable ethnological interest, but the native evidence is conflicting and very few really old utensils have been preserved. In view of the practical absence of this feature elsewhere in Polynesia it seems safest to ascribe it to European influence.

Legged containers appear to be entirely absent in the Marquesas, the nearest approach being a low transverse flange carved near either end of the bottom. This feature was observed in only one specimen, and there is good reason to believe that it was not aboriginal. In view of the importance of utensils with legs in the Society Islands and their occasional occurrence in Hawaii, their absence in the Marquesas is rather curious.

Two bowls of unusual form are shown on Plate LXI, C. No. 1 seems to be an imitation of a long cupped leaf, the short upturned handle representing the stem. In both specimens there is a deep channel at the smaller end evidently intended to direct the flow of the fluid in pouring. In No. 1 this channel ends in a well marked lip. The interior of No. 2 is coated with *kava* enamel and it is probable that both were used as *kava* bowls.

An end channel similar to that in No. 2 is a common feature of the large four-legged Tahitian bowls, while bowls with lips were occasionally made by the Maori. Elsewhere in Polynesia these features appear to be rare or lacking.

COMPARISON OF CONTAINERS

A comparison of Polynesian containers could not fail to throw a great deal of light on the relations of the different groups, but anything like a satisfactory study is impossible at present. Regions in which the containers are poorly made or undecorated are often entirely unrepresented in Museums, while many others are represented by two or three specimens at most. Under the circumstances it is only possible to point out a few obvious similarities and differences. Long oval boxes with covers were numerous in the Marquesas and New Zealand, but appear to have been unknown in Hawaii and Western Polynesia. Round boxes with tight fitting covers are found throughout Western Polynesia and in Hawaii, but are lacking in the Marquesas and New Zealand. They appear to have been rare in Hawaii, and it seems safe to assign the long

box to the marginal, and the round box to the western culture. Vessels with legs are common in Western Polynesia and in the Society Islands, but are rare in Hawaii. They are absent in the Marquesas, and the only utensils which approach this form in New Zealand are certain large gourds used for potting birds which, according to Tregear (82, p. 98), were fitted with three or four legs to make them stand upright. It is probable, therefore, that the use of legs cut in one piece with the utensil was a feature of the western culture, their absence a feature of the eastern.

A comparison of Marquesan and Micronesian containers yields some interesting results. The Micronesian containers are uniformly flat bottomed and many are provided with bases. The Marquesan containers are round bottomed and the aboriginal use of a base is questionable. The bases of modern utensils appear identical with those used in the Pelew group. (Kubary, 76, Plates 23-7.) Bird shaped containers similar to those of the Marquesas were used in Pelew and the Caroline Islands. (See Finsch, 73, p. 321, and Wilson, 83, p. 102.) These bird forms are not found in any other part of Polynesia or Micronesia.

Melanesian containers have never been studied or described as a whole, but it seems certain that the long oval box, which is a feature of eastern Polynesian culture, does not occur in this region. Legged utensils on the other hand are rather common, being most numerous in the Solomon Islands and in Fiji. Bases similar to those of the Pelew and Marquesas Islands seem to have been rather common in the Solomon Islands.

DECORATION OF CONTAINERS

Marquesan containers were decorated by several methods of which carving was the most important. The handles were decorated with seeds and bone tubes, and feathers or locks of hair seem to have been attached to the bodies of some of the containers. The lids of some bowls were covered with an incrustation of red or black seeds imbedded in breadfruit gum. Single red seeds, applied here and there, were used to heighten the effect of the carving, especially when the container was made of the dark colored *mio* wood. These seeds were either wedged in deep grooves of the carving or partly imbedded in the wood. This imbedding of seeds is an approach to inlaying, but it is significant that in spite of the strong aesthetic sense of the Marquesans and their extensive use of bone and mother of pearl in personal ornaments, they appear never to have inlaid wood with these materials.

The elaborate carved decoration of many Marquesan containers made them much sought after by collectors, and the demand for objects of this sort has led to a persistence of the art, although in a rather decadent form. In pre-

European times the carving was done with sharks' teeth, rats' teeth, or shells, but for nearly a century these implements have been replaced by implements of iron. Practically all the tools now used by carvers are home-made and are crude, but effective. They consist of small chisels, made from large nails ground to a straight edge; curved chisels, also made from nails, and small gouges, which are usually made from umbrella ribs. Knives are apparently never used for carving.

Containers are always completely shaped and polished as if for use before carving, a practise which increases the difficulties of the artist as it makes it impossible to conceal any slips of the chisel. The bowl to be carved is soaked in a stream for some time to soften the wood, and when not being worked on is usually kept in water. Only beginners draw the designs upon the utensil before carving; the skilled workman carves entirely free hand and arranges the spacing of even the most intricate designs entirely by eye. The chisel, usually fixed in a rough wooden handle, is held with the bit below the hand, and the carver appears to work with equal facility either toward or away from the body. The incision is first marked out by pressing the chisel into the wood vertically, and is then made by pushing the tool along horizontally, with one corner of the bit at the bottom of the original vertical cut and the edge, sloping upward to the surface of the bowl at a variable angle. A long triangular sliver is thus removed; any irregularities in the cutting are dressed down with small chisels. In a very large proportion of the carved specimens all the incisions have this triangular form, but when wide spaces are to be cut away they are outlined by two cuts of the sort just described, the wood between is removed, and the bottom of the space dressed flat or left with a low central ridge. Curved chisels are used to dress the vertical sides of incisions in curved designs, while the gouges are used principally for small details or shallow designs which are incised rather than carved.

Modern carvers have a strong tendency to enlarge and simplify the details of the designs and broaden the incisions in order to increase the speed of production.

Carved decoration appears to have been most commonly used upon round bowls, next in frequency being the boxes and the tureen-like covered dishes. At least some of the other forms were probably carved in pre-European times but no carved *toto* or oval bowls, with the exception of the bird effigies, are known. Bird effigies and some boxes were carved only upon the projecting knob, and a few bowls and dishes were decorated with a carved band below the rim, but as a rule the carving covered the entire outside of the utensil. In applying the designs the surface was rarely, if ever, treated as a whole, being broken up into a number of sections which were treated as separate units. In the actual process of carving the outlining of these sections upon the bowl was the first step, and the filling designs were applied afterward. A symmetrical arrangement of the sections appears to have always been intended, and there is usually more or less agreement between the filling designs of corresponding sections. In decorating a circular bowl the bottom was usually treated as a single unit, although it was sometimes divided into two or more parts. The sides were divided either into horizontal zones or vertical sections, and the boundaries marked either by plain

grooves or by narrow bands of design. On account of the shape of the vessel the vertical sections were wider at the top than at the bottom. Some specimens show both horizontal and vertical divisions. On boxes and other oval containers the arrangement of the sections appears to have been variable.

CLASSIFICATION OF DESIGNS

The material available for a study of container designs is limited. Only one of the carved containers studied appears to belong to other than the later period of European contact, and the bulk of the specimens in museums are unquestionably commercial products. Most of the modern work indicates a sacrifice of quality to quantity of production, which shows itself in slipshod work, simplification of the designs used, and an increasing tendency toward angularity. Each of the modern carvers has a tendency to ignore all but a few motifs, which he has learned to reproduce rapidly and accurately. As a result of this the work of a given carver, or that of his pupils, can at once be distinguished in a mixed collection. The style of many of the older specimens seems to indicate that a similar individual specialization in designs existed at least thirty or forty years ago, but it is impossible to say definitely that such was the case. It is probable that distinct local or individual schools of decoration existed in pre-European times; but if so, their content and differences can not now be established. The modern carvers appear to have borrowed few, if any, European motifs, and the present art is a simplified rather than a mixed one.

The simple division of designs into angular-geometric and curvilinear, used in the study of house post decorations, is unsatisfactory for containers. The best classification appears to be as follows: (1) band decorations, (2) angular-geometric designs used to fill sections, (3) design elements, (4) motifs, (5) representations of natural objects.

(1) BAND DECORATIONS

Band decorations consist of various arrangements of dots, straight lines and angles, with one arrangement of spirals, employed upon the spaces separating sections of design, and to some extent upon design elements. Bands appear rarely, if ever, to have been used to fill sections. Band designs are shown on Plate LXII as follows:

- A.* Straight parallel lines.
- B.* Straight rows of dots, used either singly or in parallel.
- C.* Parallel diagonal lines.
- D.* Herringbone patterns.
- E.* Cross-hatching.
- F.* Zigzag parallel lines, either longitudinal or transverse.
- G* and *H.* Alternate interlocking triangles, solid or filled with V's or with lines parallel to one side.

- J.* Alternate interlocking triangles separated by parallel diagonal lines.
- K.* Two rows of opposed triangles, the spaces between being filled with concentric diamonds or broken scrolls.
- L.* Bands of oblongs placed transversely at intervals equal to their width.
- M.* A combination of *L* with a row of inverted triangles, the apex of each triangle resting against the end of an oblong.
- N.* A combination of *L* with a zigzag line, apparently a modification of *M*.
- O.* Rows of pointed half ovals, each oval containing a spiral.

(2) ANGULAR-GEOMETRIC DESIGNS USED TO FILL SECTIONS

Angular-geometric designs were rarely used to fill sections. The collection included only two specimens decorated in this way. One of these is a large feast bowl from Pua Ma'u, Hiva Oa, decorated entirely with simple angular-geometric designs, most of which are like those used upon house posts. The other is a crudely carved box, locality unknown, which bears very few designs of ordinary container type. The designs used are shown on Plate XLII, *P*.

- 1. Four triangles meeting at the apex, their interiors being filled with V's.
- 2. Groups of diamonds filled with concentric diamonds or angular scrolls.

(3) DESIGN ELEMENTS

The designs here described (Pl. LXIII, *A*), although sometimes enlarged to fill entire sections, were usually incorporated into complex motifs or used to fill in the parts of a section not covered by the main motif.

A. Spirals are the commonest element of Marquesan bowl design. Both single and double spirals are employed. A few examples are true spirals of nearly circular outline. Some are triangular but the greatest number are rectangular. The double spirals appear in several forms with the turns both in the same and opposite directions. (Drawings 1-5.)

B. Circles appear to have been normally used only to outline the section of decoration covering the bottom of round bowls. Only one example of a series of concentric circle used to fill a section was found. (Drawing 6.)

C. Ovals and rectangles grade imperceptibly into each other and it is often difficult to distinguish one from the other. Both were employed either as fill, or in enlarged form, to decorate entire sections. The interiors of these figures were usually filled with concentric ovals or rectangles. (Drawings 7 and 9.)

D. Pointed ovals were ordinarily used only as parts of more complex motifs and were less common than the ovals of class 7. They were filled either with concentric ovals or with herringbone patterns. (Drawing 8.)

E. Segments of ovals were extensively employed as fill and as portions of more elaborate motifs. They were usually filled with either concentric half or quarter ovals or with hooks. (Drawings 10-12.)

F. Combs, half ovals or half rectangles whose interiors were filled with short parallel lines perpendicular to the long axis of the figure, were employed principally as details of larger motifs. (Drawings 13 and 14.)

G. *Pokaa* is the name given a small circle, oval or rectangle broken at some point in its circumference. In the container designs *pokaa* figures grade imperceptibly into small circles bisected by a groove or bar, and from these into various forms of double spiral and scroll. The term is used here to include all figures of this class not certainly spirals or scrolls although its native application is probably more limited. The extent of the variation can be seen from the accompanying plate taken from those used upon commercial clubs. The *pokaa* was used to a minor degree upon bowls, and is fairly common in modern carving, but appears to have been primarily a tattooing design. It was also used on ancient war clubs. Arrangements of two *pokaa* placed back to back and joined by a bar do not appear to have been used in tattooing, but are found in the carving. (See drawings 15 to 20.)

H. The natives designate a series of concentric circles, ovals or rectangles broken by a bar or groove extending from the center to beyond the rim as *cipuoto*. These figures grade into *pokaa* and the two motifs are closely related. They are of only minor importance upon bowls, but appear in tattooing, upon house posts, and as petroglyphs. From their use in rock carvings it seems probable that these designs have a special significance, being possibly a conventionalized representation of a vagina and phallus. (See drawings 21-27.)

I. The use of hooks of characteristic form does much to give Marquesan art its distinctive quality. These hooks are of two types: One hook has a short vertical and a long horizontal arm meeting at right angles. The sides of the vertical arm are parallel; the lower side of the horizontal arm is straight and the upper irregularly convex. The end of the horizontal end is pointed. (See drawing 28.) The second hook contains either two or three sections which meet approximately at right angles, the sides being parallel throughout and the ends straight or rounded. (See drawing 29.) The pointed hooks are rare in container decoration, but are common in tattooing. The other type of hook is constantly used in container design, ranking even before the spiral in frequency. It is used principally to fill segments of ovals or rectangles, and the arrangement is more or less stereotyped. In filling a half oval a series of three section hooks are placed with their bases resting upon the straight edge of the figure and their points at alternate ends. The innermost hooks are usually of two sections only. (See drawing 30.) In filling a quarter oval two sections are employed, the bases of alternate hooks resting against first one and then the other of the straight sides of the segment. (See drawing 31.) The hooks are always incised and the raised surface left between the cuts forms a continuous scroll which will be referred to as a hook scroll.

J. *Crosses*. Both plain (drawing 32) and staggered (drawing 33) crosses were employed, but always in connection with other designs which filled the spaces between their arms and the edges of the section.

K. Triangles rarely appear outside of the band decorations. They are used principally upon the bottoms of bowls and are filled either with angular spirals or with concentric triangles (drawing 34).

(4) MOTIFS

Motifs include the various standardization combinations of design elements other than those which appear to be representations of natural objects. These are illustrated in Plate LXIII, B as follows:

1. Crosses, either plain or staggered, with arms continued into hook scrolls which fill the four quarters of the section.
2. *Kaake*, broad, straight-ended elbow figures with ends and bodies decorated with designs. (The *kaake* motif is common in tattooing, but rare in container decoration.)
3. *Mata*. The simplest form of the *mata* consists of two half ovals (convex side downward) each of which is filled with hooks or concentric half ovals, below which centrally there is some variant of the *pokaa*. The space on either side of the *pokaa*, below the half ovals, is usually filled with small designs not connected with these main elements. The whole arrangement apparently represents a highly conventionalized face in which the half ovals serve as eyes and the *pokaa* as nose. Some forms of double spiral seem to be related to the *mata* motif. *Mata* are rather rare in container decoration, but are common in tattooing.

(5) REPRESENTATIONS OF NATURAL OBJECTS

The Marquesans appear rarely to have carved representations of natural objects other than human beings upon their containers, although a statement of Langsdorff that they carved upon their bowls "little figures of human faces, of fish and of birds" (38, p. 172) may indicate that this was done in former times. The representations of natural objects upon the containers examined may all be assigned to some one of three classes: representations of human beings, representations of animals or insects, floral designs. With the exception of the human figures carved upon one box, all such representations are highly conventionalized and are linked by intermediate forms to various purely decorative designs.

(6) REPRESENTATIONS OF HUMAN BEINGS

The decorations on Plate LXIV, *A* may be divided into three classes: more or less naturalistic figures, which occur only upon the specimen mentioned in the preceding paragraph; angular-geometric figures; and figures carved according to the tiki convention.

The naturalistic figures (drawings No. 1) are crudely executed, resembling the drawings made by a child. The persons are represented with the legs apart and the arms akimbo. The body and limbs are shown as simple lines or bands. In one example the toes are indicated. The heads are disproportionately large and the features, when shown, are grotesque. Curiously enough the faces have little or no resemblance to those of figures of the tiki type.

Angular-geometric representations of human beings appear to have been employed exclusively in the form of narrow bands (drawing No. 2). The representations consist of an inverted triangle, representing the head, below which there is a cross line for the shoulders, with three vertical lines, representing the body and arms. No other features are indicated. Representations of this sort sometimes occur in the same bands with decorations *L*, *M* and *N*, shown on Plate LXII, and it is possible that those band decorations originated from representations of human figures.

Human figures carved in the round or in relief appear to have been almost never used upon containers; but flat figures, which stand to the true tikis in the relation of a line drawing to a bas-relief or statue, were extensively employed. They evince a strong tendency to modify the body by substituting decorative elements for its various parts, or to eliminate the body altogether. The convention used for depicting the features was essentially the same as that of the true tikis, and a suggestion of the relief form is usually retained in the modeling of the eyes within and above the rings. (Drawings No. 3.)

The eyes are shown by two rings joined at the inner ends and continued at the outer ends into horizontal bars which terminate in double spirals or scrolls, representing the ear. The

bridge of the nose is usually indicated by a straight line, and the nostrils by semi-circles or semi-ovals. The mouth is shown as a simple oblong or narrow oval with a longitudinal central ridge, and in a few designs the teeth are indicated by short transverse grooves. There is usually a horizontal ridge across the eye ball, but in some figures the eye ball is smoothly rounded and in one specimen there is a distinct central disk, like a pupil. The most interesting feature in connection with the use of tiki figures is the gradual elimination of details. Not only is there a strong tendency to omit the body, but the features of the face are discarded one by one. The first to be lost is the mouth, followed, with equal frequency by the nose or ears. In a few carvings only the linked ovals of the eyes remain, and in some designs a single unmistakable tiki eye, with an attached ear, is used as a separate element.

(7) REPRESENTATIONS OF ANIMALS OR INSECTS

Three motifs appear to be highly conventionalized representations of some animal or insect. (Pl. LXIV, *B*.) Two of these motifs each occur upon one specimen only, while the third, with many modifications and variations, plays an important part in bowl design.

The simpler of the rare motifs (drawing No. 1), found in only one specimen, consists of a broad straight groove ending in a circle or semi-circle and having along either edge a fringe of diagonal lines. The whole form suggests a centipede, but it can not even be said with certainty that a representation of a natural object is intended.

A second rare motif, also found upon one specimen only, has a long narrow body in the form of a pointed oval, at one extremity of which are placed forelegs and a head and at the other hind legs with a suggestion of a tail.

The body is decorated with a single longitudinal groove and has on either side a number of short transverse grooves, apparently representing a spine and ribs (drawing No. 2). Each pair of legs, with the head or tail, is treated practically as a separate unit, the form suggesting the crosses shown in Plate LXIII, *B*, 1. The space along either side of the body is filled in the original with unassociated designs carved at a lower level. The whole treatment is so conventional that identification is difficult, but it seems probable that a lizard is intended.

The third motif is comparatively common in the modern commercial work from Fatu Hiva and shows a more or less standard form, with many examples which have been modified in various ways. The standard figure and various modifications are shown on Plate LXIV, *B*, 3.

The standard figure consists of a long oval with which are connected three pairs of spirals, two being attached at either end and the third pair somewhere along the sides. There is usually a suggestion of a head at one or both ends.

A more or less standardized variation, which may have been originally a separate motif (Pl. LXIV, *B*, 4) has a shorter and broader oval body, with or without a head, from the upper end of which spring two broad curved bands, while to the lower end are connected two spirals or separate scrolls. This form grades imperceptibly into purely decorative designs with no suggestion of representation.

FLORAL DESIGNS

Representations of plant forms are quite rare, and true floral designs are represented by only three examples. In two of these, which appear upon the bottoms of two bowls so closely similar in other details that they are probably the work of the same artist, the center of the flower is represented by two concentric circles, around which the petals, represented by small ovals, are placed radially. The interior of some of the petals is decorated with herring-bone design. (See fig. 9, *a*.) Upon a third specimen, groups of small pointed ovals, apparently representing bunches of leaves, are used to fill in the details of one of the larger designs. (See fig. 9, *b*.)



FIGURE 9.—Drawings of Marquesan floral designs.

From the specimens examined it seems that angular-geometric designs played a very minor part upon most containers, but they appear on a few specimens to the practical exclusion of curvilinear designs. Specimens showing anything like an equal frequency of occurrence of the two types of design appear to be entirely lacking. At the same time there is a strong tendency to give an angular form to designs which are basically curvilinear. This tendency is most pronounced in the new specimens. The commonest of all design elements appear to have been the spiral and the hook scroll, segments of concentric ovals or rectangles ranking next in importance. Tiki figures, representations of animals or insects and combinations of crosses and hook scrolls are the most important motifs, as distinguished from design elements. *Mata* and *kaake* are rare, while *pokaa* and *cipuoto* are not common.

COMPARISON OF POLYNESIAN CONTAINER DESIGNS

Containers decorated with carved designs appear to have been unknown in western Polynesia and Hawaii. In other regions, except Easter Island and Chatham Islands, they were used to a greater or less extent, but reached their highest

² The relation of Marquesan designs as a whole to those of other parts of Polynesia have been discussed fully in a paper by Ruth Greiner (75). Only the most important points will be enumerated here.

development in the Marquesas. A superficial study of the designs employed in the regions of their occurrence shows the following:

In southeastern Polynesia, to judge from the few examples available for study, we have a division of the surface to be decorated into a number of small sections or bands which are filled with small angular geometric motifs. These motifs are usually applied in bands, and are not as a rule combined to form larger designs. The only curvilinear form is the concentric circle.

In the Marquesas we have a division of the surface to be decorated into sections of relatively large size which are often separated by bands of simple design. These sections are treated as units, being filled with large designs formed by the combination of several design elements. Both curvilinear and angular-geometric designs are employed, but curvilinear designs are clearly dominant in container decoration. There is a tendency to give angularity to basically curvilinear forms, such as the spiral, but there is an equally strong tendency to round the angles of basically angular forms, such as the oblong.

In northern New Zealand the surface to be decorated is either treated as a whole, or divided into a very few large sections by bands of narrow design. Only curvilinear designs are employed, the dominant motif being the spiral. An important feature of the technique is the use of a beaded interline.

If we compare the southeastern Polynesian carvings with those on western Polynesian weapons, the most elaborately carved objects from that region, we are at once struck by a basic similarity in design and execution. There is the same division of the surface into many bands or sections which are filled with small angular-geometric motifs. The southeastern Polynesian examples show an additional motif, the concentric circle, and show superior workmanship, but the carvings from both regions resemble each other much more closely than they do those of either the Marquesans or Maoris.

The Marquesan and Maori carvings have little superficial resemblance, but they possess two features in common which are foreign to the regions just compared; a predominance of curvilinear designs, and an extensive use of the spiral. The toothed line, important in New Zealand, occurs in the Marquesas but is rare there. The practise of dividing the surface to be decorated into sections, constant in the Marquesas, is rare among the northern Maori, but angular-geometric designs seem to have been used in carving in some parts of New Zealand.

It appears that there existed originally in marginal Polynesia, exclusive of Hawaii, a predominantly curvilinear art which treated surfaces as a whole or in large sections. The original western Polynesian art was angular-geometric, with a division of the surfaces treated into many small sections. In the Cook Islands, Austral Islands and Society Islands, the original marginal art was almost de-

stroyed by an invasion of western culture. The strong evidences of such an invasion have already been pointed out in the case of other elements of material culture. On the side of pure decoration the original art modified that of the invaders to a very small degree. Northern New Zealand, because of its location, was practically unaffected by the western Polynesian art. The Marquesas, on the other hand, received a moderately strong influence resulting either in the introduction of sectional treatment of surfaces and angular-geometric designs or in the strengthening of these features if they were present in the original complex.

FIBER AND CORDAGE

The material most commonly used for Marquesan cordage appears to have been the bark of the *fau* tree. The bark was obtained from young shoots two inches or less in diameter and was prepared as follows: The stripped bark was soaked for several days in a taro patch or in the backwater of a stream, left until the membrane connecting the inner and outer bark had been destroyed and the outer layer had begun to decay. The inner bark was then separated, scraped, and soaked for two or three days in fresh running water. It was then spread out and dried in the sun. Almost every native household has a bundle of this dried bark, strips of which are used for all the purposes for which Europeans employ string.

True cordage was made from the dried bark by either twisting or plaiting. Heavy rope was twisted from two or usually three strands. In manufacture the direction of rotation was the same as in European rope. In order to make the rope smooth and of uniform diameter, the bark was cut in lengths of two or three feet which were worked in gradually as the twisting progressed. The finished product was somewhat softer and more flexible than a hemp rope and when new was almost equally strong, but it did not wear as well as hemp. Twisted bark rope is still manufactured to a limited extent. The heaviest made is about one inch in diameter. In ancient times much larger ropes were made, but no examples seem to have survived. Light cords and small strings were made by rolling the bark on the thigh.

Small ropes and heavy cords were usually plaited, the bark being prepared as in rope twisting except that it was not cut into short lengths.

The strands were first loosely knotted together and held by the toes until enough cord had been braided to permit of attachment to a tree or post. The plaiting was then done in the ordinary European direction, that is, toward the workman. In cords ending in a flat loop the body of the cord was frequently twisted and the loop plaited. Three, four, six, seven, and eight strand plaits were used, but only the three and four strand plaits, called respectively *toua* and *fofii*, were used for ordinary cordage.

Rope of seven strands was used for certain ceremonial purposes (32). The six and eight strand plaits form flat bands, and are still used for the leg ends of pig tethers. (See Pl. LXV, *A*.) Although most of the natives are familiar with these techniques, none of the informants questioned were able to give a name for them.

Practically all *fau* bark cordage was utilitarian, although slender black cord of this material was used with other material in a few ornaments. In the feather headdress (*paekua*) it was plaited with tapa cord to form a black and white edging. The cords of the large fish net (*upena*) were dyed red with earth

called *ka'aca* which was worked into them in the course of the rolling, but apparently there was no decorative intent. Colors other than red and black do not seem to have been used. The method in dyeing the cord black was not ascertained, but it was probably the same as that used in dyeing sennit black.

Next to the *fau* bark the material in most common use is coconut fiber. This fiber is of two kinds, that from the husk, which is short and rather stiff, and that from the leaf sheath, which is longer and more flexible, but lacks the strength of the husk fiber. Husk fiber is used for all ordinary cordage and is obtained by beating fresh moist coconut husks with stones until the tissues have been crushed and the fibers can be separated by hand. In the leaf sheath the fibers are arranged in thin layers which can easily be separated with the fingers. Sheath fiber is said to have been employed for the large nets used in turtle fishing, and for the lashings of some chiefs' houses and sacred structures. It was also occasionally used for the thin cord employed in *pavahina* and as strings for musical bows.

The heavier grades of coconut fiber cord are usually plaited, but the smallest cord is twisted from two strands while a somewhat heavier twisted cord, in a single strand, is used in one form of ornamental plaiting. Ordinary cord (Pl. LXV, D 1) was made by plaiting three untwisted strands of fiber, additional fibers being worked in as the plaiting progressed to keep the strands of uniform size.

The plaiter seated himself and, holding the end of the cord with his toes, plaited upward and away from the body. The ornamental cords used for *hue* nets and drum lashings were plaited from many strands—five, six, eight, and from nine to fifteen inclusive. They appear to have been always in the form of flat ribbons, and it is rather curious that no square four-strand coconut fiber plaits were seen although this technique was employed for some bark ropes.

Two forms of plaiting were used, one of which gave a broad thin band having the appearance of twilled fabric (Pl. LXV, D, 3), while in the other the strands ran in diagonally to the center of the band, where they passed alternately over and under (Pl. LXV, D, 2). The ends of cords made by the first technique were usually finished by short sections made by the second. In large cords made by the second technique two longitudinal strands of twisted fiber were usually used as a base, the strands of the plait passing alternately over and under these in a sort of figure eight motion. In well made cords of this type the base strands were completely covered, and the finished product gave the effect of being made from two cords tightly twisted in opposite directions and placed side by side. Many strand cords made by plaiting together elements which were themselves plaited do not appear to have been used.

Finished three plait cord is stored in long cylindrical rolls wound to give an ornamental effect. Many strand cord on the other hand is said to have been commonly wound in thin flat rolls like European tape. (See Pl. LXV, B.)

The only dyed coconut fiber cord collected was of the three strand variety, but it is probable that the more intricate plaits were also occasionally colored. All the specimens seen were reddish brown, tan or black, but red is mentioned in native stories and Stewart, a reliable authority, speaks of yellow and white sennit used in house lashings. The reddish brown and tan sennit appears to be natural. The Tongan method of deepening the color by baking, if originally known to the natives, has been forgotten. The lightest shade of tan sennit was made from fiber of the leaf sheath. Three methods of coloring the black sennit were described.

The bark of the *mai'i* tree was beaten up with stones and the juice squeezed into large wooden bowls. The finished sennit was then steeped in the juice for several days, until it became black. It was then removed and buried for three days in the mud of a taro patch, washed, and dried. A second method consisted of burying it in the mud for a longer period without the preliminary dyeing, while a third method consisted of rubbing the finished cord with a mixture of *ama* nut soot and water.

It seems probable that when mention is made to red sennit the darker shades of red brown are referred to, but at least some red sennit was made by painting the fiber, apparently after plaiting, with the seeds of the arnotto (*Bixa orellana*). Yellow sennit was colored with saffron, the cord probably being made from the light colored fiber of the leaf sheath. White sennit must, from the nature of the fiber, have been incrustated or painted rather than dyed, and it is quite possible that it was produced by rubbing the finished cord with a paste made from shell lime or from a fine white earth, extensive deposits of which occur in Nuku Hiva. This supposition is strengthened by the fact that fans were whitened in this way.

Although most Marquesan cordage was made from either fau bark or coconut fiber a number of other fiber plants were known and used. The most important of these seems to have been the pineapple. Pineapple fiber is still used for thread and for very small fish lines, and is prepared as follows:

The fresh green leaves are taken one by one, laid across a banana log, and scraped longitudinally with any sharp-edged instrument. The bowl of an ordinary metal spoon was seen used for this purpose. Continued scraping removes all the flesh of the leaf, leaving a few soft fibers which are then dried in the sun. The women convert these fibers into thread by rolling them upon the bare thigh with the palm of the hand. To make fish lines either two or three strands of this thread are twisted together, the finished line being passed rapidly through a flame to singe off the lint.

Banana fiber is said to have formerly been used for certain kinds of cord, but this material has not been employed for many years. To prepare the fiber,

banana stumps were beaten until the soft parts and fiber separated. The fiber was cleaned, washed and dried, and then rolled into cord by the process just described for pineapple fiber. The only remembered use of this cord was in the making of *pehe* or string figure.

Jardin (33, pp. 32-59) mentions the use of certain other fiber plants. No accounts of these were obtained from the natives but the information appears to be reliable. The species are: *pakoko* (*Phaseolus amoenus*) of which Jardin says (33), "The flower shoots are very flexible; the natives make from them lines for catching fish;" *papa*, an unidentified legume, which, according to Jardin, "serves like the *phaseolus amoenus* for the making of threads;" and *pute* (*Pipturus propinquus*) of which the same author says, "The natives use its branches, which are very flexible, to make large ropes."

Other materials, which can scarcely be classed as fiber, were *tapa*, and a variety of long grass, unidentified, called by the natives *mauomatito ne tetahia*. The *tapa* was sometimes twisted into strings for the suspension of ornaments, but had so little tensile strength that it was usually reinforced with a strand of coconut fiber about which the *tapa* was wound. Strips of grass are said to have been plaited into cords which were used by girls in a game, but no more exact information could be obtained.

A discussion of knots and splices belongs under the general head of cordage and fiber, but it is quite impossible to distinguish at the present time between native forms and those of European origin. The Marquesas became at a very early time a regular port of call for whalers and a number of the natives served and still serve as sailors on European ships. It is not surprising, therefore, that they soon acquired a knowledge of all the European knots and splices and have for many years used them as skillfully as any white sailor.

MATTING AND BASKETRY

MATS

The twin arts of matting and basketry appear to have been less developed in the Marquesas than in any other part of tropical Polynesia and both have been nearly destroyed by European contact. No mats of the better sort are now manufactured and the processes employed are unknown to most of the natives. Only three materials appear to have been used for mats, ti leaves, coconut fronds, and the leaves of the pandanus. Mats made from ti leaves were small crude affairs, hardly deserving the name. They were used only to line and cover *ma* pits. (See Pl. LXVI, A.) They were made as follows:

A quantity of the leaves were collected and the stems and heavy portion of the midrib removed, without breaking the inner surface of the leaf. These stemmed leaves were laid in bundles of three or four, the face of each leaf being against the back of the one below. These bundles were then placed side by side with a wide regular overlap, always from the same direction, and were pinned together with splints about two inches long made from the midrib of a coconut leaflet or from bamboo. Three of these splints were used to join each pair of bundles, one being placed in the middle and the other two near either end. In doing the work a long splint was used; a portion of the end of the splint was broken off each time and left as a pin. The resultant mat was as wide as the length of the leaves and could be extended indefinitely by pinning on new bundles.

Coconut mats are still regularly made in the Marquesas; the work is done by men and women indiscriminately. They are employed mainly as thatching for houses, to cover large earth oven and in ancient times they were used on beds, under the fine mats. The coconut mats are made as follows:

A coconut frond, usually that of a young tree, is split longitudinally and the midrib, to which the leaflets of either half are attached, is pared thin enough to be rather flexible. Alternate leaflets are then directed forward and backward and interwoven in a simple checkerwork. The outer edge of the mat is finished by braiding the tips of the leaflets together in a continuous longitudinal strip. The size of these mats naturally depends upon that of the frond from which they are made, ordinary specimens being 14 to 20 inches wide and 6 to 12 feet long. A common variation of this technique is to employ two half fronds placed side by side, the midribs being joined together by twisting a leaflet around both at intervals of one to two feet. The leaflets of both fronds are then interwoven to form a mat of single thickness like that just described. A still further variation consists in placing two half leaves together with the midribs at opposite edges and interweaving the leaflets in checkerwork. This last technique is rarely used at the present time.

The better Marquesan mats, used principally upon beds, were made from pandanus. These bed mats were as a rule long and comparatively narrow, being intended to cover the space between the two coconut logs. They were of two sorts, the distinction being apparently one of shape and use. The mats upon which the legs rested were called *moena*, those upon which the body rested *kahuaa*, those for the head *p'ai p'ai*. (For shape and arrangements of these mats

see p. 283.) According to Handy (personal correspondence) there was a kind of coarse mat, called *hupau*, which was used by poor people.

No pandanus mats have been made in the Marquesas for several years, and the information obtained in regard to the methods of manufacture was insufficient and sometimes contradictory.

The dry or half dead leaves appear to have been used. The base, midrib and thorny edges were cut away with a pearl shell scraper or knife of the sort used in scraping bark for tapa, leaving two long straight strips about two inches wide. According to one informant, these strips were then soaked in sea water for a few days, washed in fresh water, and dried in the sun. The extreme softness of some of the mats would seem to indicate that the dried strips were beaten or otherwise manipulated before weaving, but no information could be obtained on this point. Before weaving the broad prepared strips were split with a small stick like a needle into narrow sections which varied in width according to the degree of fineness of the contemplated mat. These strips were called *henu* (32). Marquesan mats appear to have been quite coarse as a rule, the width of the strips in all the specimens seen averaging three-eighths of an inch. The weaving was done entirely by women and the manufacture of some mats for special purposes was attended by ceremonial observances. According to one informant the work was done upon a sort of lap-board placed across the knees. Some mats were of single, others of double thickness, but the same methods were employed in making both, the double mats differing only in having each element made from two strips of the leaf laid one upon the other. The weave was a simple checkerwork, the warp and weft being indistinguishable and the strips running at an angle of forty-five degrees with the edges of the mat. Each element, as it reached the edge, was folded over and woven back into the mat at right angles to its former direction. A weft strip thus became, when turned and carried back, part of the warp. In one specimen, apparently a section cut from a large mat, the ends are finished by cutting off the ends of the warp strips and bending back and reweaving these of the weft strips in the manner just described. The sides of this mat are finished by the first method. In a second specimen the edges are finished in a more complicated manner which gives an ornamental effect. (See Pl. LXVI, B.) The exact technique can not be ascertained without injuring the specimen.

Marquesan mats were rarely if ever decorated with woven patterns, but one specimen in the Bishop Museum (Pl. LXVI, C) is embroidered in simple overlay with thin strips made from the upper surface of the pandanus leaf and dyed brick red. The decoration consists of six narrow strips, each two elements wide, two of which are placed at either end of the mat as a border while the other four are arranged longitudinally at equal intervals, the outermost strips being about four inches within the sides of the mat. According to Handy (personal correspondence) the cuttings of women's hair were sometimes saved and woven in tufts around the edges of mats.

In view of the scanty material available for study it is quite possible that mats of finer grade than those described were manufactured in ancient times, but the general inferiority of Marquesan mats is mentioned by various early visitors. Petit Thouars (48, p. 348) says that the mats were coarser and less ornamental than those of the people living further west, and the wife of one of the first European missionaries sent to the group from Hawaii mentions, in a letter

to friends, that she had gathered a few of the women together and was teaching them to weave coarse mats. This statement is so remarkable, implying as it does an ignorance of the art, that it is difficult to account for unless mat weaving, like certain other industries, had become more or less localized so that the valley in which the missionaries settled bought its mats ready made.

BASKETS

The manufacture of all but the simplest baskets had been discontinued in the Marquesas in 1920 and only two types of basket were remembered by the informants questioned. Both of these were made from coconut fronds. The simplest type *koaho* (Pl. LXVI, *D*) is still manufactured, and is made as follows:

Four short sections of coconut midrib, to each of which three leaflets are attached, are placed two at either end of the proposed basket and the leaflets interwoven in checkerwork to form the broad, oval bottom. Four similar sections, bearing two or three leaflets each, are then placed in pairs above the first four and their leaflets interwoven with the ends of those forming the bottom, making the sides. Three of the bottom leaflets are left projecting beyond the basket at either end and these are braided and the braid carried up over the outside of the basket to the rim. The rim is finished like the edge of an ordinary mat. When the body of the basket is finished, a bunch of tips project from either end. The braids from the bottom are combined with these tips and the whole plaited into a broad flat cord. The cords from the two ends are tied together above the center of the basket to form a handle, and the receptacle is ready for use. Baskets of this sort can be made in a few minutes. They are used principally for carrying fruit.

The more elaborate type of coconut basket called *hakete* (Pl. LXVI, *E*) is no longer regularly manufactured; the specimen figured was made to order by an old woman who remembered the process:

Young fronds just beginning to unfold were used and the two sides of each leaflet were folded together before weaving so that the midrib lay along one edge of the strip. The basket was made as follows: The frond was taken and prepared as for mat weaving. Sections 3 to 5 feet long, depending on the size of the desired basket, were then cut from the corresponding portions of the two halves, and the leaflets of each section interwoven tightly at the base, each leaflet passing over two in the direction of its natural angle with the midrib. All the leaflets of each section thus ran in the same direction. The midribs of the two sections were then placed together in such a way that the leaflets of one ran at right angles to the leaflets of the other and were bent into a long oval, their ends being tied together with short pieces of bark string. This formed the rim of the basket. The leaflets of the two sections were then interwoven in a twilled pattern, over three and under three, those of one section forming the warp and those of the other section the weft. This weaving was continued down to the juncture of the bottom with the sides, where there was a narrow strip twilled over two and under two. The bottom, which was very narrow, was made in two thicknesses. The inner layer was formed by interweaving the warp strips of the two sides in a simple checkerwork, their tips being bent back and plaited together in a long strip beneath the checkerwork. The outer layer of the bottom was formed by bringing the weft strips of the two sides together along the middle of the bottom and there plaiting them into a flat braid. The braids from both the inner and outer layers were concealed between the two sections of the double bottom, but their tips projected upward, one at either end, on the inside of the basket. No handle was made, the basket being suspended by cords passed under the rim at either end. Baskets of this sort were used principally for carrying fish.

Edge Partington (20, p. 46) figures a closely woven basket of coconut leaves of still a different type. It is oval in outline, with a flat bottom, vertical sides and a flat recurved top, making the opening considerably smaller in diameter than the body of the basket. No baskets of this sort are now in use and the form seems to have been forgotten.

In the collection of the Peabody Museum at Cambridge there are two rather curious sacks from the Marquesas.

The material is split pandanus similar to that employed in mat weaving. The sacks are almost identical in size and construction and are rectangular, $14\frac{1}{2}$ inches long and 11 inches deep. The form is that of an envelope with a triangular flap. The body of the sack is of double thickness, the outside layer being made of strips $\frac{1}{4}$ inch wide except for the last 3 inches below the top. The sack above this point, the flap, and the inner layer, are woven from much finer strips produced by splitting each of the $\frac{1}{4}$ inch strips in three. The technique is a simple checkerwork. A loop of twisted coconut fiber is attached to the center of the lip of the sack and passes up through a hole in the flap, protruding for 2 to 3 inches when the sack is closed. There is no information as to the use of these objects.

Jardin (33, p. 36) says that the natives wove coarse baskets from the flexible shoots of the *tutu* (*Ceanothus asiaticus*), but gives no data to their form or the technique employed.

FANS

Marquesan fans were of two sorts, ordinary fans, which are still manufactured and used, and chiefs' fans, which were carried by persons of importance and were intended for show rather than use. The chiefs' fans are now obsolete, and no examples have been preserved in the group. They are fairly numerous in collections, however, and the type may be accurately described.

The coconut fans have a broad straight outer end and sides which are nearly parallel at the tip and curve inward smoothly at the base. All the specimens seen were more or less asymmetrical (Pl. LXVI, *F*), but this did not appear to be intentional. They are made as follows:

Young coconut leaflets are folded so that the midrib lies along one edge of the woven strip. The weaving is begun at the outer end, a flat band, twilled over two and under two and as long as the width of the proposed fan, being woven first. The twill in this band is longitudinal, and the whole is rarely more than seven elements wide. The direction of the twill is then changed to vertical, and the fan woven down to the upper end of the handle. To form the handle the two leaflets which are central at that point are crossed and carried down vertically, each succeeding pair being similarly detached from the weaving, crossed and braided in with those already detached until all have been included. The ends of these leaflets, which extend some distance below the fan, are then packed closely together, wrapped with bark string, and cut off squarely at the tips, the whole forming the handle.

The following description of chiefs' fans (Pl. LXVII, *A*, *B*) is based upon an examination of specimens in the possession of M. George La Garde of Papeete, and in various American museums. The weaving appears to have been uniform; the technique being as follows:

The outer end of the fan, which was similar in shape to the coconut fans just described, was finished with a straight band twilled over three and under three. The body of the fan was also twilled, but the weft strands passed under one and over two. The warp strands radiated from the outer end, those next the handle being vertical and parallel while those of the wings diverged more and more as the tips were approached. The exact method of finishing the edges could not be determined. The upper end of the handle was provided with a long spike which was incorporated into the fan, the weft threads being interwoven about it. Near its base it was encircled by ornamental lashings of fine sennit laid on in a simple diamond pattern. The strips used in the woven part of the fan were one-eighth of an inch or less in width. The lower end of the handle might be either a continuation of the wooden spike or a separate piece of human bone or whale ivory. In most cases it was elaborately carved with four small tiki figures arranged in two pairs, superposed upon one another, the figures of each pair being back to back. These fan handles rank among the finest products of the Marquesan artist and it would be difficult for Europeans to better some of them either in design or execution. The woven portion of the fan was whitened by rubbing with lime or with a white clay found in Nuku Hiva, the application being heavy enough in many cases to fill the interstices of the weaving and make determination of the technique and material difficult. The material appears to have usually been the young leaflets of the coconut palm, but it is possible that pandanus was also used in a few instances.

These elaborate fans were made by special *tuhuna* and seem to have had a distinct ceremonial significance, being carried by chiefesses at *koina*, and by chiefs and *ta'ua*. Those of chiefesses at least were inherited in the female line, and appear to have been almost insignia of rank.

It seems well to describe here a very curious fan of tortoise shell, collected in Atu Ona, Hiva Oa. (See Pl. LXVII, C.)

The fan consists of a rather rough wooden handle to which plates of tortoise shell have been attached. The object is in bad condition, but the original shape appears to have been rectangular. The handle is decorated with a few tresses of human hair tied with coconut fiber, like those used in hair ornaments. Fans of this sort are said to have been used to keep flies off a dead body while it was undergoing mummification. The specimen obtained had been partially cut up for the sake of the tortoise shell, a good indication that these objects had no religious significance.

ARTICLES USED IN GAMES

This section includes the various objects which were used by the natives in their sports and amusements. The best known and most striking of these toys are the stilts.

STILTS

Marquesan stilts are made in two parts, a shaft and a step. A modern stilt is illustrated on Plate LXVIII, *A*. The shaft consists of a round pole of some light wood, usually *fau*, with a diameter of 2 to 3 inches and a length of 5 to 7 feet. In the best made specimens the upper end is carved into a rounded grip. The stilt shafts are carved with simple designs.

For convenience in description the step may be considered as having two parts, a long lower section, which rests against the shaft, and a projecting upper portion or foot rest. In an average specimen the lower section is $9\frac{1}{2}$ inches long, with a width of $1\frac{3}{4}$ inches at the upper end and one inch at the lower end. The inner side is slightly concave, to fit the stilt shaft, the concavity being deepest at the top. The foot rest in the shape of a broad hook, with a strongly convex outer, and slightly convex inner surface, and a rounded end.

In the commonest type of ancient stilt steps (Pl. LXVIII, *B*, 2) the space between the lower section and the foot rest is bridged by a small human figure, its buttocks and legs carved in high relief upon the lower section, while its head rests against the foot rest.

The whole effect is that of an Atlantid or Caryatid. The space behind the body of the figure is pierced and serves as an eye through which the lashings are passed. These figures are carved in compliance with the ordinary tiki convention, with a disproportionately large head, short arms, and short flexed legs. The face shows the usual spectacle eyes, scroll ear, flat nose and broad mouth, and the top of the head is encircled by a narrow band bearing simple incised designs. The arms are shown either at the sides, with the hands resting upon the stomach, or raised on either side of the head as if to help support the weight of the foot rest. Most bodies show slight modeling, the line of the collar bone and the nipples and navel being indicated. The entire body and limbs are usually covered with shallow grooves, arranged to conform to the contours, while similar grooves in either straight or geometric patterns, cover both the inner and outer surfaces of the footrest.

In a specimen in the Peabody Museum of Cambridge a whale's tooth pendant from a cord is carved in low relief around the neck of the figure.

There were a number of variations from this form of step. Two figures carved back to back were often used with their sides against the step, or two figures were placed one above the other, the lowest carved in high relief, while the body of the upper figure was in the round. In this design the upper figure was frequently represented as kneeling (Pl. LXVIII, *B*, 1). A specimen in the Bishop Museum is decorated with two superposed figures of rather fantastic form, and has flat tiki faces carved on the foot rest. (Pl. LXVIII, *B*, 3). The space behind the figures is pierced. This specimen is obviously modern and unused, and it seems probable that it is a degenerate example made for sale.

The step was attached to the shaft by sennit lashings passed around both, one set of these lashings covering the space behind the tiki figure while the second set of lashings encircled the step below it. The shaft was wrapped with tapa at the point where the step was attached. Black and red sennit are said to have been used for the lashings and it is probable that the strands were laid on in ornamental designs. The stilts were used in the ordinary European way, the instep of the foot resting against the shaft. The upper end of the shaft was grasped in the hand and lifted at each step.

The ancient Marquesans are said to have been unusually expert stilt walkers, running races over smooth pavements and engaging in knocking down contests. Native boys now engage in these contests. The antagonists face one another and, balancing on one stilt, extend the other stilt and make a quick swinging blow at the bottom of the enemy's stilt, recovering instantly. The sport continues until one or the other falls.

In view of the mountainous nature of the country, and the lack of soft or even level ground, it seems impossible that stilts could have been developed locally. They were used in Hawaii, the Society Islands and New Zealand, but do not appear to have been used in Samoa or Tonga. It seems safe, therefore, to consider them as a feature of the marginal, as opposed to the western Polynesian culture.

COCONUT SHELLS

Small children frequently walk on coconut shells in solitary play. This sport is possibly related to stilt walking. From the numerous half shells thrown out by the kitchen the child selects two of equal size which are from the stem end of the nut. He then passes a loop of string through the eyes and inserts the big toe of either foot between the sides of the loops, holding the upper ends in his hands. In walking he lifts the shells by the loop at each step. The game seems to be a solitary one, the child stamping back and forth over the pavement of the house *pae pae* and enjoying the clatter.

DARTS

One of the most important Marquesan games was dart throwing, called *teka*. This game is still occasionally played, and a few of the darts were seen.

The darts are made from straight pieces of upland reed or from hard wood switches and are about four feet long and one-half inch thick at the head. They are prepared simply by stripping off the leaves.

In playing the game a level open place is chosen.

A small round mound of hard earth is built, and the darts are thrown against this in such a way that they glance up and on down the course. The dart which travels farthest is the winner. The darts are sometimes thrown with a card (*aho*) which is a thin string, knotted at one end. One end is wrapped once around the dart near its center, being held in place by the tension at the knot, while the other end of the throwing cord is wrapped around the first finger, and the shaft grasped with the rest of the hand, keeping the cord taut. When the dart is thrown the cord causes it to rotate, making it fly straighter.

There appears to have been a second dart throwing game in which somewhat heavier darts were used.

In this game the darts were thrown at a mark. In throwing, the larger end of the dart was balanced upon the palm of the left hand, while the smaller end was held in the right hand with the index finger across the tip. The darts were held at about the height of the waist and were propelled with an underhand motion.

Games similar to the Marquesan *teka* were of nearly universal occurrence in Polynesia.

POHUTU

Pohutu consisted of bundles of fau leaves rolled up and bound with pandanus strips, the whole forming a ball about two inches in diameter. One of the pandanus strips was left projecting for some inches to form a handle. The game was played by a single child who held the pandanus strip in one hand and batted the ball with the other, or by two children, one of whom held the strip while the other struck the ball. *Pohutu* were also used in the *pei* game, in which genealogies were repeated. The *pei* game, as described by Handy, suggests a close resemblance between the *pohutu* and the well known *poi* balls used by the Maori.

BALL AND PIN GAME

Langsdorff (38, pp. 172-3) describes a toy concerning which no information was obtained. He says:

Under the title of playthings may be mentioned one which consists of a stick about a foot long and an inch thick. A hole is bored in it at one end through which is run a peg five or six inches in length, and at the point of the peg is stuck a little ball of coco-thread. The stick is then struck with another, so that the ball is thrown up into the air. The game is to catch the ball upon the point of the peg. It is very probable that they have other objects of amusement of a similar kind, which may be ranged as playthings, but no others came under my observation.

TOPS

Tops, called *niu*, are still extensively made and used in the group. They are made of fau wood, an average specimen being 7 inches long and 2½ inches in diameter, with a cylindrical body and pointed head. The shape is almost exactly that of an ordinary artillery shell. They are spun by means of a whip. This whip consists of a stick handle about one foot in length with a lash of fau bark 2½ to 3 feet long, which is braided to within a few inches of the tip. Several boys usually play at tops at the same time, the winner being the one who can keep his top in motion the longest.

BOW AND ARROW, AND SLINGS

The bow, called *pana*, was not a weapon in the Marquesas. It was sometimes used to shoot shrimp, and *po'oko*, a small fish which frequents the rocks,

but as these could be captured by other and much easier methods it seems probable that the shooting was a sport, and that the bow was only a toy. No Marquesan bows seem to have survived, but according to information obtained by Handy they were made of guava or *toa* wood while the arrows consisted of shoots of bamboo, pointed at one end. The arrows, and the species of bamboo from which they were made, were called *kohe*. The bow string was called *aho*. The form of the musical bows now in use would suggest that Marquesan bows were semi-circular in cross section, with a flat outer and rounded inner surface, but this is purely surmise.

Elaborately made slings were employed in warfare, while a smaller and cruder form was used by boys as a toy. These toy slings were made from ti leaves, which were braided together to form the cords, while the pocket was formed by the natural width of the leaf. In use the long end of the cord was wrapped around the hand and the short, or release end, held between the thumb and finger.

WEAPONS

Every Marquesan tribe was normally at war with its neighbors, but the warfare does not appear to have been of a very deadly character, consisting for the most part of desultory raids for heads or to capture victims for sacrifice. The native armament was entirely offensive and consisted of slings, and of various types of spears and clubs. The bow, although known, appears never to have been used in war.

In spite of their knowledge of the sling, stones thrown by hand played an important part in Marquesan warfare, the shorter range of such missiles being compensated for by their greater accuracy. Any Marquesan battlefield would offer an abundance of ammunition, and, to judge from the modern natives, a stone throwing warrior would be decidedly dangerous up to forty or fifty yards.

SLINGS

Slings, with specially prepared sling stones, were used for all long range fighting. The stones were oval or double conical and sometimes weighed as much as half a pound (Pl. LXX, B). They were made of heavy close grained rock and the specimens seen were symmetrically pecked, but unground. Porter (49, pp. 86-87) says that they were highly polished by rubbing against the bark of a tree. According to one informant, round sling stones were also used, but the only specimen seen appeared to be unworked. In battle the stones were carried in nets slung from the waist, or, in sea fights, were piled in the bottom of the canoe.

No satisfactory information in regard to the form of the ancient slings was obtained from the natives, but specimens preserved in the Peabody Museums at Cambridge and at Salem, prove that two forms were in use. (See Pl. LXX, *A*.)

The simpler of these, represented by a single specimen, consisted of a broad flat plait of coconut fiber, between five and six feet long, without a pocket. The cord tapered at either end, one extremity being finished with a loop for the fingers and the other with a simple knot. In another form the two cords were slender and there was a pocket of coconut fiber about five inches long with a central width of about two inches tapering toward either end. The end of the sling that was retained in throwing was also made from coconut fiber, while the release cord might be made either of coconut fiber or of twisted fau bark. A short distance from the end of the retained cord a loop two to three inches long was formed by dividing the braid into two strands which were again interwoven beyond it.

In a specimen in the British Museum figured by Edge-Partington (20, p. 46, No. 2) the end of the retained cord was finished with a small tiki figure of human bone from which hung a hair tassel. As may be seen from the photograph the pockets were often elaborately and beautifully woven. Some specimens of the second type are over five feet in length when ready for action, giving the thrower great range but little accuracy.

A warrior going into battle carried his sling wrapped around his hand and Langsdorff (38, pp. 150-160) says that natives from other valleys, when attending feasts, "commonly have with them a sling for stones, but it is bound around the head so as to have rather the appearance of an ornament than a weapon of defence."

Most early visitors agree that the Marquesan slingers were poor marksmen, but Porter, who fought against them, says (49, p. 87)—"The stones are thrown with such a degree of velocity and accuracy as to render them almost equal to musketry." Evidence of the force of slung stones is offered by a missile of this sort in the valley of Omoa, Fatu Hiva. The stone has been driven into a crack between two rocks so solidly that the repeated efforts of curio hunters have failed to dislodge it.

SPEARS AND LANCES

Several types of spears and lances were employed by the Marquesans, but very few examples have been preserved. There are no authentic specimens in the museums of the Atlantic Coast. The only spear remaining in the group, as far as known, is a short javelin preserved as an heirloom in the family of the chief of Ta'aoa, Hiva Oa. This spear is approximately five feet long with an average shaft diameter of three-quarters of an inch. The lower end tapers to a blunt point, while the upper end is flattened and expanded laterally to form a sharp edged blade whose form may be seen from the accompanying illustration drawn by Mrs. E. S. Handy (fig. 10). An entirely different type of throwing spear is mentioned by Porter (49, pp. 86-87) who says: "The other kind [of spears] are smaller, of a light kind of wood, and are thrown with much accuracy

to a great distance. At certain distances from their points they are pierced with holes all around, in order that they may break off, with their own weight, on entering the body, and thus be more difficult to extract."

Desgraz (15, pp. 282-3) mentions a toothed javelin intended to break off in the wound, but the reference is obscure.

There are a few early mentions of lances of *toa* wood used in hand-to-hand fighting, but none of these are explicit enough to merit quotation. Fleurieu (23, p. 132) says that these lances were 9 to 11 feet long, Porter (49, p. 86), that they were 14 feet long. Some of these weapons are said to have been toothed, others plain. A curious form of lance, described by a native informant,



FIGURE 10.—Outline of Marquesan spear.—Drawn by Willowdean C. Handy.

had upon one side three long barbs, cut in one piece with the shaft, which were deeply notched at the base. When an antagonist had been stabbed, the foremost barb would be broken off by a quick twist and left in the wound while the spear, when withdrawn, would still serve for a second and third thrust.

Edge Partington (20, First series, Plate 43) figures two Marquesan spears of unusual form. In these weapons the shaft is made of "a hard red wood" and the heads of a "dark hard wood." The dark wood is almost certainly *toa*.

The shaft of the spear thickens toward the head. The point appears from the drawing to be inserted in a hole in the end of the shaft. There are no indications of lashings or other attachments. The points are rather slender in proportion to the shaft, and are carved with a series of low barbs. In one example the barbs alternate on opposite sides, in the other they are placed in pairs.

Spears with detachable heads, and many pointed spears appear to have been used primarily in fishing. (See p. 397.)

CLUBS

Two varieties of club were used in the Marquesas, one of which, the *uu* (Pl. LXIX, D) is a fairly common object in collections. The *uu*, which have frequently been figured and described, show great uniformity in shape and decoration and only minor differences in size and weight. An average specimen has a length of 4 feet, 6 inches with a head 18 inches long.

The handle of the club is round or oval in cross section, with a diameter of about 1¼ inches and a slight lateral flare at the butt. At its upper end the handle gradually flattens and expands laterally to form a peculiarly shaped head of two distinct parts. The lower part is oval in cross section, with sharp edges; at the outer end the head thickens abruptly, having a thickness of 3½ inches at the tip. Near the top of the sharp edged part there are two lateral knobs, each diamond shaped in cross section, with a flat end. The heads of clubs of this

type are elaborately carved according to a set convention, the decoration of the numerous specimens examined varying only in minor details (Pl. LXIX, A).

Each side of the club is treated as a separate unit, but the arrangement and position of the various decorative elements on the two sides, and to a lesser degree the designs employed, correspond. The carvings upon a single side are arranged as follows:

At the lower end of the expanded portion, next the handle, there is a broad transverse band composed of decorative designs. Above this is placed a tiki face, minus the mouth, whose ears rest against either edge of the club. Above this face in turn, filling the space between it and the bottom of the knobs, is a narrow band of carving broken in the center. The inner ends of the sections are connected by narrow curved bands, or the space between them is filled with one or two small detached designs. Above this band, on the line of the lateral knobs, a small tiki face in high relief is carved centrally. The section above the lateral knobs is divided into two equal parts by a low longitudinal keel and upon each of the halves thus formed is carved a large circle or oval having in the center a head in high relief from which lines run radially to its circumference. Above these circles, on the extreme end of the club, a flat tiki face is carved centrally. The curve of the thick outer end of the club extends upon either side to within about two inches of the lateral knobs and in a few specimens small faces, directed laterally, are carved at its lower extremities.

Practically all old *uu* have a glossy black finish given by burying the finished implement for some time in the mud of a taro patch and then rubbing and polishing with scented coconut oil (*pani*).

The *uu* have always been much sought after by collectors and this demand has resulted in their continued manufacture although the best modern examples are only caricatures of the ancient specimens. The carefully worked out contours of the old clubs have given place to flat surfaces and angles, and the simple and rigidly conventionalized decoration to elaborate and meaningless carvings. The finish of the modern specimens is usually rough, and the wood is always left the natural color, making them easily distinguishable. (Pl. LXIX, B.)

The second type of Marquesan club, called *parahua* (Dordillon, 17) is also well represented in collections. It has a handle identical with that of the *uu* but the elaborately worked out head is replaced by a sharp edged blade closely similar in form to that of a modern American canoe paddle (Pl. LXIX, E). Weapons of this type appear never to have been carved or blackened, and are as a whole longer than the *uu*. Some of these paddle clubs are remarkable for their size and weight, one specimen in the Bishop Museum being 7 feet, 9¼ inches long with a blade length of 2 feet, 10½ inches and a maximum blade width of 7 inches.

In many *uu* and *parahu* there is a small hole pierced through the expanded lower end of the handle, probably for the attachment of a wrist loop, and in some specimens the grip is wrapped for a distance of 5 to 8 inches with fine plaited

coconut fiber cord, to which tufts of white beard are attached at irregular intervals.

An example of a chief's son's scepter (*kouvai*) (Pl. LXIX, G) was obtained from a burial cave in the valley of Atu Ona, Hiva Oa. According to informants a *kouvai* was made for the son of a chief at the time a new house was built for him. It was thrust into the thatch and left there, and was never carried or used. Elaborately carved clubs resembling the *uu*, but degenerate in form, are still made by the natives and sold as chiefs' scepters or insignia, but it seems doubtful whether the form is an ancient one.

The staffs carried by chiefs and persons of importance were made of *toa* wood, with a shaft diameter of $\frac{3}{4}$ to $1\frac{1}{4}$ inches and a length varying from 5 to 10 feet. They were rarely carved, but a specimen in the Bishop Museum bears two pairs of small tiki figures carved upon the shaft at considerable intervals. The lower end was flattened and expanded to form a narrow flat edged blade, the amount of this expansion being highly variable (Pl. LXIX, F). One specimen in the Salem Museum is really a narrow paddle club.

The upper end of the staff was decorated with a band of woven coconut fiber and terminated in a pompom of human hair which was attached as follows (Pl. LXIX, C): The tip of the shaft was carved into a projecting pin about $1\frac{1}{2}$ inches long. The hair, in the form of small locks attached to coconut fiber cords, was then applied piece by piece, the cords being tightly interwoven about the pin. In one specimen in the Salem Museum a tress of white beard is attached to the tip of this braiding. The sleeve of coconut fiber enclosing the upper end of the shaft consisted of a weft of single fibers applied upon a longitudinal warp of thin cords of plaited fiber in a very close wrap weave. This sleeve was usually decorated with simple designs produced by variations in the weaving or with geometric figures in black produced by embroidery in human hair. The technique of this embroidery is rather interesting, a warp strand being detached from the fabric and wrapped closely with the hair, then re-incorporated. The figures are as a rule large and simple.

It was not determined whether or not these staffs were ever used as weapons.

The only Marquesan weapon suitable for close combat was the *ake henua* which, according to Handy, was a double pointed spike of *toa* wood having about the center a loop of cord through which the wearer's wrist was passed. This weapon was carried only by *toa* or great warriors. It is said sometimes to have been thrown.

HEAD TROPHIES

Marquesan warriors preserved and elaborately decorated the heads of slain enemies, although no trace of these trophies was found either in the Marquesas or in American museums. What appears to be an accurate description is given by Desgraz (15, pp. 296-298). He says:

[133]

. . . bony skull, the lower jaw of which is firmly held in place by small plaited strings, very fine and very well arranged around the articulation. These are united by another larger and stronger plait which is prolonged in front of the incisor teeth of the two mandibles and passes under the chin and ends at the nodes behind the arch of the palate. At either side of the dental arch a large and strong wild pig tusk is fastened by these plaits to the bone of the cheek so that it appears to spring from the mouth of the individual in the same manner that it sprang from the mouth of the animal to which it belonged. A piece of hard wood, roughly carved, fills the anterior opening of the nasal fossa and more or less represents an abnormal nose. The eyes are imitated by large pieces of pearl shell fitted into the orbits [of the skull]. A small round piece of tortoise shell serves in place of pupil and a few hairs placed between the shell and the orbit represent the lashes of this lustrous eye. Finally, to complete this hideous assemblage, a few tresses of the vanquished one's hair are attached to the lower jaw by way of a beard and hang down below the chin.

Radiguet (52, p. 67) gives a description of such a prepared head which he found in a hole in one of the *me'ae*, as follows:

. . . human skull whose orbits were filled with brilliant disks of pearl shell, flat, and as large as a five franc piece. A hole pierced through the middle showed black in guise of a pupil. A piece of pointed wood filled the nasal cavity. Two teeth, long and menacing, had been driven into the alveolus of the canines. Finally, cords of coconut fiber attached to the maxillaries numerous tufts of hair disposed as a beard and to the ears oval wooden plaques whitened with chalk. The lower jaw was lacking.

A crude drawing of a head trophy of this type appears in one of Langsdorff's illustrations (38, p. 118).

The prospectus of Von den Steinen's forthcoming book on Marquesan art contains an illustration of a human skull covered with painted tapa, but it differs entirely from the trophies just described and was probably a religious object. The paintings upon it apparently represent facial tattooing.

COMPARISONS

The use of slings, with or without specially prepared stones is almost universal in Polynesia and Micronesia, with a scattering use in Melanesia. In New Zealand the sling appears to have been obsolescent, being regularly used only by the Urewera tribe (Tregear, 82, pp. 314-15), and prepared sling stones seem to have been unknown. In the Society Islands (Ellis, 71, p. 290) and in Samoa and Tonga prepared stones do not appear to have been used although the sling was important. In Hawaii and the Marquesas oval or bluntly double conical stones appear to have been normally used. In Micronesia the use of specially prepared sling stones seems to have been universal. The Micronesian specimens are easily distinguishable from those of either Hawaii or the Marquesas because of their greater length and smaller proportional diameter. Some of them are almost cigar shaped.

It is not possible to get exact information as to the type of sling used in Samoa and Tonga. In Tonga the bow and arrow was the important missile.

The Hawaiian and Micronesian slings are much cruder in construction than the Marquesan slings, and have little in common with them. The Marquesan and Society slings, on the other hand, are practically identical, corresponding not only in form, but even in such minor details as the occasional use of fau bark for the release cord. It is rather curious that such close correspondence should be coupled with the use of prepared stones in the Marquesas and their absence in the Society Islands.

The information on Marquesan spears is too incomplete to justify extensive comparison, but it is suggestive that the practise of cutting or piercing the shafts of javelins so that the head would break off in the wound appears to have been limited to the Marquesas and New Zealand. The thrusting spear with long easily broken barbs appears to have no Polynesian parallel, but is rather suggestive of certain north Australian forms.

A comparison of Polynesian club forms is especially interesting. The Hawaiians seem to have made only secondary use of the club, and the Hawaiian examples for the most part are short bludgeon-like weapons of rather inferior workmanship. There are some indications that a longer bat-like type was also in use, but it seems to have been numerically unimportant. The Marquesans seem to have entirely lacked short clubs, both their types, the *uu* and paddle club, being heavy and of unwieldy length. The natives of the Society Islands used clubs of two types, one a short bludgeon, the other a long club with a sharp edged lozenge shaped head. Examples of the long club examined strongly resemble the spears of the Cook Islands which in turn, appear to be copies of metal prototypes. The Maoris used several types of club which seem to fall into two classes, long staves and short, sharp edged weapons, such as the mere. The Maori weapons are well known. In Samoa and Tonga we find a great variety of clubs, most of which are of types also found in Fiji. These weapons have been fully described by Churchill (69). As a whole they show little resemblance to the forms found in marginal Polynesia. Even the nuclear Polynesian paddle clubs bear much less resemblance to those of the Marquesas than the Marquesan ones show to some Melanesian weapons, notably those from the Solomon Islands.

No clubs at all resembling the Marquesan *uu* appear in other parts of Oceania, and it seems certain that it is a local development. If we ignore its decoration we find that the *uu* differs from the paddle club only in the thickening of the end and the lateral knobs. The handles of the two types are identical, and in both the head has a rounded outline, flat oval cross section, and sharp edges. It is evident that the *uu* as a whole represents a highly conventionalized face to which the knobs bear the relation of ears. As projecting ears are a common fea-

ture of Marquesan figures it is quite possible that the knobs might be added to a paddle form on which a face had been carved with the idea of rendering the human likeness more complete. The thickening of the end is more difficult to account for, but this also may have arisen from the native artistic convention which calls for wide curves over the eyes. It is but a slight step from the paddle club to the *uu*. Evidence of the priority of the paddle club is offered by the use of small replicas as chiefs' insignia.

The distribution of narrow-bladed staves is especially interesting. In Polynesia their use appears to have been limited to two localities, the Marquesas and New Zealand, with a related form in Easter Island. The Marquesan staves are as a rule longer than those from New Zealand, but the blade form is practically identical, the differences between the two types lying in the treatment of the upper end, or head, which in New Zealand was usually carved into a head with a projecting, pointed tongue, and in the Marquesas was finished with a pompom of human hair. In both, the shaft immediately below the head was covered with a woven sleeve. The Easter Island implements are clearly related to these staves, but differ from them in having a broader blade, no sleeve, and an upper end carved into two heads placed back to back. The Marquesan staves grade into the paddle clubs, although they always retain the characteristic decoration of the head. As paddle clubs appear to be lacking in both New Zealand and Easter Island it seems improbable that the staff was developed from this weapon. Certain Melanesian digging sticks now in the Field Museum are identical in blade form with the Maori and Marquesan staves, and there are even a few examples in which the upper ends are carved and decorated. A. B. Lewis of the Field Museum says that he has frequently seen digging sticks employed as staves by the older men in Melanesia, and it would appear not improbable that the staves of the Maori and Marquesans have been derived from some such tool. The fact that the Maori staff was an important weapon does not militate against this assumption, as even among the Maori digging sticks were sometimes used as weapons while many of the Melanesian examples are known to have been used interchangeably as tools and clubs. The Fijian chiefs' staves lack the flattened blade, just as do many of the Fijian digging sticks.

It is rather curious that large weapons edged with sharks' teeth appear to have been entirely lacking in the Marquesas, although at least two forms were in use in the Society Islands (Ellis, 71, p. 297, p. 413).

Weapons resembling the Marquesan double pointed spike (*ake henua*), were rather common in Hawaii, while a related form was important in the Society Islands. Their use in Samoa and Tonga seems doubtful, although the data from those islands is still too incomplete to allow of a definite statement.

APPARATUS USED IN FISHING

The Marquesans used four methods of fishing; poisoning, spearing, hook and line fishing, and net fishing. The first of these methods was by far the simplest, but owing to the rugged nature of the coast there were few places in which it could be profitably employed. Three substances were used; the fruit of *Barringtonia speciosa*, the flowers of *Tephrosia piscatoria*, and the leaves and young shoots of *Rhyncosia punctata*. (The use of *Rhyncosia punctata* may be post-European.) The use of the *Barringtonia* appears to have been limited to small pools in the rock; the fruit was split with a flake knife and rubbed on the rocky sides of the pool, stupifying the fish and causing them to rise to the surface. The *Tephrosia* and *Rhyncosia* were used for deep fishing. Holes or small caves among the rocks were located by diving. A quantity of the crushed poison was enclosed in leaves, forming a tight bundle, and with this the fisherman dived, shaking the poison out into the caves. He then returned to the surface and waited for the stupified fish to rise.

FISH SPEARS

Large fish, especially the giant ray (*fafaua*) were speared from canoes. The spear was provided with a detachable head to which a line was attached. The head was made of hard wood or bone, its upper end was cut with a jog which rested against a corresponding jog on the end of the shaft, and was attached to the shaft by light lashings. The form of this head can be seen from the accompanying photograph of a specimen in the United States National Museum (Pl. LXX, C), although the carved decoration is unusual.

Smaller fish were speared from the rocks with a many-pronged spear. Only a general description of this implement was obtained, but one form called *matavau* (Handy) is said to have had twelve prongs attached to the shaft by three rows of sennit binding. The natives also swam after certain species of fish and speared them in the water, a practice still common in the Society Islands and the Tuamotus.

The spearing of fish from the rocks, and most of the net and hook fishing, were carried on at night by the light of torches. These torches were of three sorts; those made of sugar cane (now obsolete), of bamboo and of coconut fronds.

The sugar cane torches are said to have been made by tying up the leaves of a dry stalk into a compact bundle. Coconut torches were made from a single dry palm frond. Beginning at the tip, the leaflets were directed upward and tied by passing single leaflets around the bundle at intervals of a foot or more. Such a torch when lit at the tip needed no tending, and would burn down gradually with a good light. Bamboo torches were made by crushing a long dry joint of bamboo, care being taken not to break it across. The scattered fibers held the bunch of dry strips together without additional binding. This form is the one most used at present for night fishing from canoes.

HOOK AND LINE

Line fishing was carried on both from the rocks and from canoes. On the southern side of Hiva Oa the natives resorted to submerged banks which lay several miles off shore, and fishing expeditions to the various uninhabited islands of the group were not uncommon. The lines used in deep sea fishing were made either of fau bark or coconut fiber; those used by the women in fishing for small fish were made of pineapple fiber. (See p. 379.)

A variety of hooks were used, their size and material varying with the nature of the fishing. A tiny hook, made from a single thorn from the edge of a pandanus leaf, was used to catch the little fish in the rock pools. Larger hooks were made either from pearl shell or human bone or a combination of the two. Simple shell hooks (Pl. LXXI, *A*, 1) were laboriously ground out of a thick pearl shell. The gleam of the nacre served as a lure and made bait unnecessary. Such hooks were barbless with only slightly recurved points and had much the shape of a "J." The upper end was slightly notched on one or both sides for the attachment of the line. A more elaborate form of one piece hook is shown (Pl. LXXI, *A*, 2). A composite hook made entirely of pearl shell was also employed. (Pl. LXXI, *A*, 3.) One section of this hook corresponds to the one-piece hook except for slightly greater angularity at the bend. The second piece consisted of a simple band of shell of the same width and length as the shank of the first piece. It was bound to the shank with lashings near the top and bottom, the nacre sides of the two pieces being brought together so that the surface of the completed hook was dark except at the barb. The type is represented only by several specimens in the Salem Museum, and no information in regard to it was obtained in the Marquesas. This form seems to be a purely local development and does not occur in other parts of Polynesia.

One-piece hooks of human bone were occasionally used, made from the curve of the lower jaw. Desgraz (15, p. 285) says that they were sharper than the pearl hooks and that their form was angular rather than oval, but as no specimens have been preserved in American collections exact description is impossible.

Composite hooks of shell and human bone were used to troll for bonito. The ancient form with only slight modifications continues in use to the present date. (See Pl. LXXI, *B*.)

The body of a hook of this sort consists of a strip of shell $3\frac{1}{2}$ to $4\frac{1}{2}$ inches long and about $\frac{5}{8}$ of an inch wide, pointed at one end and square at the other. In making this strip the pointed end is ground from the valve. Some strips are as much as $\frac{3}{4}$ of an inch thick at the point while the body of the strip is rarely over $\frac{3}{16}$ of an inch thick. The outside of the shell, which forms the bottom of the strip, is ground down until it shows a good luster with a pink, yellow or brown tint. The color is very important, for the strip serves as a lure, and fish refuse to take hooks which are not of the right shade. The thick point of the strip is pierced

by a single horizontal or vertical hole. The square end has along either side two to six notches which are used to facilitate tight lashing of the bone barb. In the specimens examined there was also a short longitudinal groove in the center of the lower surface which served no practical purpose. The point of the hook is of bone, with a slight but well marked barb just behind the tip on the lower side. The modern Tahitian and Tuamotuan hooks of the same type are usually barbless. The base of the bone point is pierced with two holes. The point is attached to the strip by close lashings, formerly of coconut fiber cord. The ends of the lashings are gathered together into a single strand at the forward end of the bone point and carried along the upper surface of the strip to its pointed end, where they are again attached to it by lashings passed through the hole in the strip. The strand is continued beyond the hook and serves to attach the whole to the line. As the lashings at the inner end of the hook are loose enough to allow some play, the pull of the line comes directly at the base of the bone point. When a fish strikes, the pull is said to draw the point slightly downward and inward, making escape more difficult. This movement, if it occurs at all, is negligible, but the pull coming at this point does serve to tighten the lashings and prevent the point from slipping on the strip. The bark upon the point is of little value, and unless a tight line is kept the fish will escape.

In some hooks of this type a small bunch of pig's hair is tied transversely at the rear end of the strip as an additional lure but this is not a constant feature (Pl. LXXI, B, 1). In one specimen collected an additional strip of shell is tied to the upper side of the main strip, probably with the idea of strengthening and weighting the hook.

That sinkers were employed in line fishing is shown by two terms given by Dordillon (17); *pokau*, which is defined as a sinker, and *pokoe*, which is defined as a stone twisted with a fish hook which falls off when the hook sinks to the depths. It seems probable that such sinkers were unworked pebbles.

Dordillon also gives a term (*pe'etai*) which he translates as "to fish with a line while swimming" but this method is now obsolete and no information was obtained in regard to it.

NETS

Net fishing was probably the most important of the Marquesan methods of fishing, and a considerable variety of nets were employed. Very few of these nets have been preserved in collections, however. The only specimens studied were two imperfect fragments in the Bishop Museum. One of these fragments evidently formed part of a small net in the form of a flat pouch or envelope with square corners. (Pl. LXXI, C).

The net is woven of two-strand fau bark cord hardly more than $1/32$ of an inch in diameter with a very small mesh decreasing in size from $3/8$ of an inch at the bottom to $3/16$ of an inch at the top. The upper edge is finished with a single strand of twisted fau bark cord about three times as heavy as that forming the body of the net. Immediately below this edging a second cord of the same weight runs around the net, apparently serving as a draw-string. The second fragment is so badly torn that the original form of the net cannot be determined. It is woven of extremely fine two-strand pineapple fiber cord scarcely heavier than carpet thread, with a uniform mesh of $5/8$ of an inch. The form of knot employed in both nets may be seen from the accompanying drawing (fig. 11).

The only large nets used in modern times are long seines woven from commercial cotton cord with needles and spacers of ordinary European form. Small circular hoop nets and flying fish nets are also made from cotton cord of

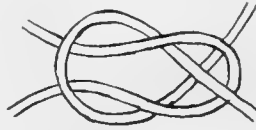


FIGURE 11.—Drawing of knot used in fish nets.

finer grade. A netting needle, similar to that used in Hawaii, is used to make these nets. The work is begun at the top and the envelope is held open, as the work progresses, by pointed strips of bamboo.

The natives of Pua Ma'u, Hiva Oa describe ten varieties of net formerly made and used, as follows:

(1) **Timana:** A circular bag net about three feet deep and two feet in diameter woven of either fau bark or coconut fiber. Three ropes were attached to the upper edge of this net at equal intervals, and were woven together into a single strand above its center. A large stone was placed in the bottom as a sinker, and the skin of a squid was attached to the juncture of the ropes as bait. The net was allowed to lie on the bottom for some time, and was then pulled up, the pull of the ropes closing the net and imprisoning any fish within it.

(2) **Maa:** A small dip net with a wooden hoop and pole, usually made of pineapple fiber.

(3) **Ho'ohe to'o:** Same as *maa*, except for the size of the net. *Ho'ohe* is the name of a small fish.

(4) **Pafio:** Same as the *ho'ohe to'o*, but of larger mesh and heavier material. This was used to catch crabs on the rocks.

(5) **Pafio Mao'o:** Net used for flying fish. There is some doubt whether this form is aboriginal, its introduction is ascribed by some to early Hawaiian missionaries and by others to certain Gilbert Island fishermen who at one time lived in the Marquesas. The modern flying fish net consists of a small bag net woven between the prongs of a forked stick, the outer edge being held taut by the tension of the sticks. Fork and net are attached to the end of a pole 10 to 15 feet in length. This form of net is used only in night fishing from canoes. A large torch is set up in the canoe and the flying fish, attracted by the light, rise to the surface and lie there. The net is slapped down over the fish, which jump upward and become entangled in it. The man using the net stands up, and as the native fishing canoes are extremely narrow and unsteady it is an exciting sport.

(6) **Pafio ihe:** A net identical with the flying fish net except for its smaller size. It is used for *ihe*, a variety of small fish.

(7) A special net was used in the Island of Ua Pou for catching parrot fish. The name of this net had been forgotten. It is said to have been about three feet square. The top was held open by crossed sticks. To the juncture of these sticks a live parrot fish was tethered by the gill. The net was then towed along the rocks where parrot fish were plentiful. According to the natives, each parrot fish has a special area from which it feeds, driving off invaders of the same species, and as soon as the tethered fish entered such a private domain the owner came out and attacked it. The net was then drawn up.

(8) **Paoa:** A long seine of fau bark. This form could be used at Pua Ma'u, where the beach shelves gradually, but was useless in most localities. One end of the seine was carried out from the beach by men wading or swimming and then brought back to the beach again at a point 75 to 100 yards away. It was then drawn in from both ends, with all the fish within the circle trapped. Such seines were provided with light wood floats along the upper edge and stone sinkers on the bottom.

(9) **Fifi:** Probably the same as the *fifi'i* of Dordillon's Dictionary, which he defines as a small net to catch turtles. According to native informants this was a very strong, large meshed seine made of cord twisted from the fiber of the coconut spathe. It was much wider than the *paoa* but like it was provided with floats and sinkers. The method of use was as follows: The net was set a short distance off any rocky place where the turtles were abundant, its line running more or less parallel to the shore. When in place, a number of men jumped into the water between the net and the shore and frightened the turtles, which, in their efforts to escape, became entangled in the net. As soon as it was evident from the movement of the floats that one had been caught a man dived down, disentangled the turtle, and tied it with fau bark cords, bringing it to the surface and giving it to the men in one of the canoes. The net was not drawn until the fishing was ended. From ten to twenty turtles were sometimes caught in this way in a single day.

(10) **Upena:** By far the most important of the Marquesan net forms. Descriptions obtained by Handy in Atu Ona and by the author in Pua Ma'u differ in some details. According to Pua Ma'u informants the cords composing it were made of fau bark twisted by rolling them on a smooth breadfruit log. According to informants of Atu Ona the cords were composed half of fau bark and half of plaited coconut fiber and were rolled upon the thigh. Both agree that at the time of rolling the cords were rubbed with a red earth called *ka'aea* which gave them a permanent color supposed to attract the fish. Ten men with coconut baskets were required to bring the earth for dyeing a single net. The net was woven by women skilled in the art under the direction of a *tuhuna upena*, the labor occupying twenty to thirty women for ten days or more. The work was carried on in a special house and was attended with various religious observances. In Pua Ma'u the *upena* was said to have been circular, about thirty feet across at the rim and decreasing gradually toward the bottom. The whole net was woven in one piece, the mesh being two fingers wide on the sides and somewhat less on the bottom. The upper end was held open by flexible poles or withes of *toa* wood placed about the circumference. The weight of the withes caused the net to sink. The net of Atu Ona is said to have been 30 to 36 feet square, tapering toward the bottom, which was finished by a special piece, "shaped like the crown of a hat," which was called *to'o pu'u*. Along the upper edge of each side was fastened a log of *toa* wood, to either end of which a line was attached.

The method of handling the *upena* appears to have been the same in both localities.

Four canoes set out about four hours before dawn with the net, two of these being large craft which carried eight men each, and two smaller, with a crew of three men each. When the fishing place was reached each of the large canoes put out four anchors, two at the bow and two at the stern. These anchors apparently were placed by the small canoes, one of which, called *vaca iti*, went to the east side while the other, called *vaca vaho*, went to the west. The net was then lowered between the two large canoes. When the net was submerged the *tuhuna* who supervised the fishing dived in and directed whether it was to be moved backward or forward. A skilled *tuhuna* was said to be able to see the fish under water and to hear them when they entered the net. When he considered the net full it was hauled up. The *upena* was drawn several times on a single trip.

Fishing with the *fifi* and *upena*, and probably with the *paoa*, was a community matter, and had associated with it elaborate religious observances.

This probably holds good also for the organized fishing expeditions to offshore banks and desert islands in which hooks and lines were used. Ordinary fishing, on the other hand, whether with small nets or hook and line, appears to have been a matter of individual initiative. The community fishing was participated in by men only, while individual fishing was done by both men and women.

According to information obtained by Handy, a strong large-meshed net (*uʔena fiʻifiʻi*) was used for catching the hammer-head shark, called by the natives *matake*. The cords of this net were dyed with red earth like those of the regular *uʔena*. The net was long, one end resting on the bottom while the other was held at the surface of the water by floats. A number of nets of this sort were set in a good locality and left for the sharks to be caught by the gills.

According to another informant, sharks were not caught in nets, but were taken by tempting them alongside a canoe with meat and passing nooses over the head and tail; the nooses were drawn taut and the shark was pulled on board and clubbed. It is probable that both methods were in use, being employed in different localities or for different species of shark. The flesh of the hammer-head was considered the best for eating, but even small tiger sharks are still caught and eaten by the natives.

Dordillon gives a term *auoa*, which he defines as "long braids of leaves to hem in fish." This probably refers to a seine of coconut leaves of the sort still commonly used in the Tuamotus for fishing in shallow water. This method is not used by the Marquesan natives at the present time and there are few places in the islands where it could have been employed. The Tuamotuan seines are simply long ropes of coconut fronds tied together in such a way that the leaflets project in all directions. They are used to surround sections of the reef or lagoon, being gradually drawn in until the fish are confined in a small compass. The fish are then speared. Whole villages assist in this sort of fishing, the seines being in some cases nearly half a mile long.

Octopi are commonly fished for by diving and thrusting a blunt pointed stick into the center of the arms. The animal twines its arms around the stick and is thus easily withdrawn from it hole. The use of octopus hooks in ancient times is doubtful, but according to one informant octopi were formerly caught with three hooks lashed back to back a short distance above which was attached a white stone. This grapnel was let down immediately above the octopus which was irritated by the stone and began to reach for it. As soon as one of the hooks had taken hold, the animal was drawn up with a quick jerk.

At least one form of fish trap is said to have been used in ancient times, but no description of it was obtained.

MUSICAL INSTRUMENTS

DRUMS

In musical ability the Marquesans appear to have been inferior to the Tahitians and the Hawaiians, but they possessed a number of musical instruments, the most important of which were drums (Pl. LXXII, *A*). That these were made in a variety of forms and sizes is indicated by the following terms from Dordillon's Dictionary³:

Pahu.	Drum.
Pahu peiei.	Small drum.
Pahu ua.	Double drum.
Pahu me'ae.	Large drums used in the <i>me'ae</i> .
Pahu putuu.	Short drum.
Pahu ooeo.	Small drum used to accompany songs.
Pahu tapete.	Long narrow drum.
Umi.	Drum.
Teveteve.	Drum.
Pere.	Kind of small drum.
Uhaki.	Small drum played with the <i>uhaki</i> .
Pahu vanana.	A thin drum, perhaps six feet high, made of <i>tou</i> wood; it was beaten as an accompaniment for the singing of the <i>vanana</i> by the men in the <i>me'ae</i> .
Utū.	A small drum used at feasts.
Pahu umi.	A small drum.
Tutu.	Small drums played on the <i>tohua</i> .
Pahu anana.	Big drums beaten from a <i>paepae</i> .

Unfortunately several of the drums in this list can no longer be identified. The *pahu ua* must have constituted a distinct type, but no information in regard to it was obtained and no examples seem to have survived. Except for the *pahu ua*, all the Marquesan drums figured or preserved conform so closely to a single type of design and construction that it seems probable that they differed only in size and in minor details. They may be described as follows:

The smallest drum seen was slightly more than thirteen inches high with a head diameter of six inches. The largest, a *pahu me'ae*, had lost its base through decay, but must originally have been more than eight feet high with a rim diameter of nineteen inches. The bases of even the largest drums seem to have been comparatively low, the differences in height resulting from variations in the length of the body.

All drums were hewn from a single piece of wood. Some very large drums were apparently made from *temanu*, but the decay of the wood made identification difficult. Drums of ordinary size appear to have been uniformly made of *mio*; and as only the dark heart wood was used, very large trees must have been required. The body of the drum was shaped with adzes and the interior hollowed with chisel and mallet. Fire does not seem to have been used.

The body of the Marquesan drum was cylindrical. In drums of ordinary size the diameter was slightly greater at the bottom than at the top, but in the very large temple drums

³ Translation and explanatory notes by E. S. Craighill Handy.

the diameter seems to have been uniform. The bodies of at least 90 per cent of the drums were decorated with a series of shallow horizontal grooves, apparently made with an adz. In a few drums the upper part of the body was decorated with simple angular-geometric designs of the sort used on house posts. It is possible that the bodies of some of the temple drums were smoothly finished. The lip of the drum was somewhat recurved, as in round bowls of normal type, the greatest width of the interior being one to two inches below the rim. The bottom of the excavation was bluntly conical. The thickness of the walls varied in different specimens but rarely, if ever, exceeded one inch.

The body and base of the drum were hewn in one piece. The interior of the base was cut away and its sides were pierced at intervals so that the body seemed to rest upon six to eight thin, flat legs connected at the bottom by a broad ring. The ring was commonly decorated with a few broad shallow horizontal grooves. As a rule, the legs of the drum were smoothly finished, but a few seem to have been decorated with simple angular designs. Through the top center of each leg two holes were pierced, one above the other, for the attachment of the hoop lashings. In drums of ordinary size the base was wider than the body and tapered inward toward its top, but in the temple drums the diameter of base and body seems to have been uniform.

A wooden hoop made of a split withe encircled the base of the drum just below its juncture with the body. It was attached to the drum by means of ornamental lashings of small sennit, which were passed through the holes and around the sides of the legs. In all the drums seen natural color sennit was employed and the design was a simple diamond. In one specimen tufts of human hair had apparently been laid upon the outside of the hoop before the lashings were put on.

The drumhead was made of thin shark skin, put on wet. In the edges of the skin, which extended for some distance down the sides of the drum, vertical slits were cut at regular intervals. A heavy cord of flat braided sennit was passed several times around the drum, threaded in and out through the slits in the skin. This lashing was so arranged that there was always an equal number of strands inside and outside. Thus, if we designate four successive slits in the skin as A, B, C, and D, the cord on the first circuit would lie outside between A and B, inside, against the wood, between B and C, and outside again between C and D. On the second circuit it would lie inside between A and B, outside between B and C, and inside again between C and D. In this way a ring of sennit was formed around the lower edge of the head. The arrangement of the lashings connecting this ring with the wooden hoop on the base of the drum is clearly shown on Plate LXXII, *A*. The lashings consisted of a series of loops of heavy sennit cord. The upper ends of the cord passed under the outer lashings of the ring on the outer sides of each pair of slits. The cords forming the outer sides of adjoining loops thus crossed each other at the slits and were carried down nearly parallel. For approximately the lower third of their length the cords were united into a single strand by wrappings of sennit. According to one informant, carved tubes of human bone were sometimes threaded upon the paired cords just above the sennit wrapping. When it was necessary to tighten the lashings these tubes would be forced upwards, drawing the cords together, thus increasing the tension. A different method of tightening the lashings appears to have been employed ordinarily. A number of turns of ribbon-like sennit were wrapped around the body of the drum about midway between the ring and hoop. When these were drawn taut the vertical loops of sennit were forced inward against the body of the drum, tightening the head.

Stewart (59, p. 258) says that the small drums used at dances were made of kou wood, and had a small hole in the center of the bottom. He also says (59, p. 257) that the heads of the temple drums were made of ray skin instead of shark skin. No drums with a hole in the bottom were found, but Stewart is a thoroughly trustworthy observer and his statement is sufficient to establish their existence.

Even the large temple drums appear to have been beaten with the hand. Because of their great length they were placed on the ground beside special platforms on which the drummers stood.

TRUMPETS

As Marquesan musical instruments, trumpets (*pu*) stand next in importance to drums. They are made of *mio* wood and of *Cassis* and *Triton* shells.

The body of the wooden trumpet was a simple tube tapering toward the upper end. (See Pl. LXXII, *D*.) Dimensions of an average specimen are: length, 1 foot, 9 inches; diameter at mouth, $6\frac{3}{4}$ inches; diameter at upper end, 3 inches. The walls vary in thickness from slightly less than $\frac{1}{2}$ an inch at the lip to approximately 1 inch at the upper end. A mouth piece of bamboo, 8 inches to 1 foot in length and approximately 1 inch in diameter, was fitted into the small end of the tube. It was not attached in any way, and when the instrument was not in use was usually removed and placed inside the wooden part. A few wooden trumpets were decorated with carving; an unfinished specimen in the Bishop Museum bears several designs which appear to have been copied from tattooing.

The trumpet was blown in the same manner as an European bugle. The trumpets still in use give a remarkably clear and penetrating note. One old informant stated that trumpets of this sort were blown by returning fishing parties to summon the villagers to the shore, but no other uses were mentioned.

Two varieties of shell trumpet were used by the Marquesans. The smaller, which appears to have been somewhat rare, was made from the shell of *Cassis rufa* by grinding away the apex of the whorl. A *Cassis* shell trumpet found in a burial cave in Atu Ona, Hiva Oa, can still be blown and gives a clear but not very loud note. (See Pl. LXXII, *B*.)

Most Marquesan shell trumpets appear to have been made from the large shell of *Triton tritonis*. The larger shells of this variety were brought up by divers from considerable depths and seem to have been highly valued.

To prepare the shell for use a hole was ground in the side of one of the whorles a short distance below the tip of the shell, and above this a mouthpiece, made of a small gourd, was attached with breadfruit gum. Handy was informed that the mouthpiece was made of bamboo, but this practice certainly was not general. Langsdorff (38, p. 164) says that the mouthpiece was made from an oil nut, but he is probably in error, for the *ama* nut is too small to have been used in this way.

Triton shell trumpets were usually provided with a band of sennit which served for decoration and also for the attachment of a suspension cord. (See Pl. LXXII, *C*.) A hole was cut in the farthest projection of the lip by sawing a transverse groove in the outer surface of the shell until the channel was reached. A number of small sennit cords were passed through this hole, along the top of the shell, then around the body of the shell a short distance below the apex, and back to the hole again. The separate strands were laid side by side and fastened together at intervals of three or four inches by transverse cords of sennit applied as in simple wrap weaving. There was thus a loop around the apex of the shell and a broad band running longitudinally from the loop to the lip. At either end of the broad band were placed additional lashings from which short loops were made. A long thick cord made from twisted white tapa passed through these loops and served for the suspension of the shell. A tassel, attached just above the lip end of the band, consisted of a number of tresses of human hair which were fastened to strands of sennit in the same manner as in hair ornaments. A tube of human bone, carved into a tiki, was threaded over the sennit cords and concealed all but their inner ends. One of the trumpets examined had been broken and mended with pieces of pearl shell glued on with breadfruit gum.

Triton trumpets were highly prized and were used in war and in religious ceremonies. Old specimens are still quite commonly to be found in *me'ae*. According to Handy the Triton trumpet was called *putona*, and the shell itself *vehine na te mano*, "wife of the shark." The maternal uncle of the first child born in a chiefly family announced the event by a blast on a trumpet of this kind.

FLUTES

The Marquesans used both mouth flutes and nose flutes.

The nose flute, called by the natives of Hiva Oa *puhekuheku*, is made from a single joint of bamboo $\frac{3}{4}$ to $1\frac{1}{4}$ inches in diameter and 15 to 20 inches long. The upper end of the flute is closed by the septum of the joint, while the lower end is open. The blow hole is in the side of the instrument, immediately below the septum, and the stops in most flutes are placed in the lower half of the tube, in line with the blow hole. (See Pl. LXXIII, G.) In historic times the holes appear to have been made by burning with a hot iron. The usual number of stops is two, but some instruments have three and a flute found by Handy in Ua Pou (Pl. LXXIII, F) has four stops, two of which are placed a short distance below the blow hole; the other two in the usual position. The lower end of this flute is roughly cut, suggesting that it was originally longer.

In ancient times nose flutes were sometimes decorated with burned designs made with a stone or bone point heated in the fire.

A peculiar nose flute in the Bishop Museum (Pl. LXXIII, E) attributed to the Marquesas, is made from a joint of bamboo $22\frac{3}{4}$ inches long and $1\frac{5}{8}$ inches in diameter and is closed at both ends.

Along one side of the flute are five holes, each about $\frac{1}{4}$ of an inch in diameter. The top hole is close to the septa of the joint while the others are placed at equal intervals. In line with the central hole two others are pierced at equal intervals in the circumference of the tube. The flute is decorated with burned designs of decidedly non-Marquesan character so that its Marquesan origin seems doubtful. It is probably Tongan.

Nose flutes are now obsolete in the Marquesas, and very few persons can play them properly.

In playing, the instrument is held with the edge of the closed end resting against the septum of the nose and the blow hole below and a little distance away from the right nostril. The body of the flute inclines downward and to the right and most of the knack in playing the instrument lies in holding it at the correct angle. The upper end is supported in the left hand, the left nostril being closed by the thumb. The stops are manipulated with the fingers of the right hand. In the Ua Pou specimen the two upper stops must have been played with the left hand. Several of the flutes seen had one of the stops plugged with a wad of coconut fiber, and it is said that a beginner would learn to play well upon one stop before attempting to use more.

The ordinary mouth flute (*puakahau*) (Pl. LXXIII, D) is still used throughout the Marquesas. One informant believed that it was not an aboriginal instrument, but if foreign it must have been introduced at an early date.

The mouth flute is made from a long joint of bamboo, rarely over three-quarters of an inch in diameter. The upper end is closed by the septum of the joint. The sound is produced

by a tongue about five-sixteenths of an inch wide, made of the inner layers of the bamboo, which acts upon the same principle as the reed of a clarinet. This tongue is placed just below the septum and as it has a tendency to stick, one or two hairs are often drawn across under it at the bottom. There are usually three stops, but in rare instruments four may be present. These stops are placed at equal intervals, the distances between them corresponding to the distance from the lowest stop to the bottom of the flute. The actual distances between stops vary in different flutes, but the regular spacing seems to be a constant feature. In observing the process of manufacture it was noted that the distances were measured by the width of the first two fingers of the right hand. Unlike those of nose flutes the stops of the *puakahau* were always cut (not burned) out.

A curious form of *puakahau* (Pl. LXXIII, C) for which there seems to have been no special name, was made from two pieces of bamboo one of which fitted accurately inside the other.

The larger piece, which formed the upper end of the flute, was closed, and was provided with a tongue. The stops were cut in the smaller piece. The section bearing the stops could be slid in and out, varying the pitch of the instrument. A flute of this sort was tuned to harmonize with another of ordinary type when the two were to be played together.

Some *puakahau* were made of two, or even three, pieces of bamboo which fitted together closely. Such instruments could not be tuned but they might be taken to pieces and carried in a small space.

Players of the *puakahau*, as of the nose flute, began by mastering one stop before attempting to use more. *Puakahau* are still occasionally used for dances, but in recent times have been employed principally by the men in courting. In former times there are said to have been regular *puakahau* orchestras, composed of as many as twelve men, who were trained to play together. Such orchestras took part in fetes and dances, but it is doubtful whether they were employed in religious ceremonies.

WHISTLES

Bamboo whistles are still used by the children as toys, but they agree so closely with European whistles in shape and principle that it seems doubtful whether they are aboriginal (Pl. LXXIII, A).

Whistles are made from a section of bamboo eight to twelve inches long and about one inch in diameter. The lower end is closed by the septum of the joint while the upper end is cut at a long angle and plugged with a piece of wood cut exactly like the plug in an ordinary wooden whistle. A hole is cut in the side of the bamboo just below the inner end of this plug.

The Marquesans occasionally use a hybrid wind instrument, half whistle and half flute, which the natives believe to be aboriginal, but the type appears to be very rare. The upper end of this instrument is identical with that of the whistle, but three stops, like those of the *puakahau*, are cut in the lower part of the tube. In the specimen illustrated (Pl. LXXIII, B), two of the three stops have been plugged with cloth.

The following names for flutes have been recorded by Handy, or compiled by him from Dordillon's Dictionary:

Puihu. Nose flute. (D.)	Ki kohe puru. Nose flute. (H.)
Putetue. Nose flute. (D.)	Ki. Flute. (H.)
Ivi tahi. Flute. (D.)	Vivo (Nuku Hiva dialect). Flute with three holes.
Ia piananai, ia piveueu. Flute. (D.)	

JEW'S HARPS

Bamboo's Jew's harps are still used in the Marquesas by boys and young men.

The main part of the harp consists of a strip of bamboo six to eight inches long and about one inch wide. It is split from a large joint, so that it is only slightly curved. A deep narrow notch is cut in the center of one end of this strip; a thin flat strip of bamboo, slightly wider than the notch, serves as a vibrator. This vibrator is not attached to the wider strip, but is laid on its concave surface, covering the notch and protruding two or three inches beyond the end of the wider strip. The instrument is held in the left hand, with the convex side of the wide strip against the mouth. The player blows through the notch, meanwhile striking the projecting end of the narrow strip rapidly with the right hand. Jew's harps seem to have been used only as toys.

STRINGED INSTRUMENTS

The only aboriginal stringed instrument now used in the Marquesas is the musical bow called *utete*. (See Pl. LXXII, E). At the present time it is practically obsolete. It was seen only once in the valley of Pua Ma'u, Hiva Oa.

The body of the modern bow is made of fau wood, and is flat on the outer, and convex on the inner surface. An average specimen is three feet six inches long, with a central width of one inch, tapering to $\frac{5}{8}$ of an inch at the ends. The string is usually made of slender iron wire, but a very thin cord, twisted from the fibers of the leaf sheath of the coconut palm, is still occasionally used. One end of the cord is twisted around the bow, while its opposite end, which is knotted, is caught in a narrow slot in the wood. To increase the tension, small stones or little pieces of wood, like bridges, are placed under one or both ends of the string. In playing the instrument one end is held in the teeth while the body of the bow projects almost horizontally to the left. The bow is supported by the left hand and the string tapped rapidly with a slender baton made from the midrib of a coconut leaflet. Handy was informed that the bow was made of *mio* and that the string was plucked with the fingers of the right hand.

The musical bow was primarily a woman's toy, but is played by persons of both sexes at the present time. The note is quite faint, being almost inaudible twenty feet away, but being held in the teeth, sounds quite loud to the player.

Dordillon defines the word *kikoua* as a "kind of shell lyre" and *e pukava kikoua* as a "lyre." This would seem to indicate the former existence in the Marquesas of stringed instruments other than the musical bow, but no examples of these have survived, and no information in regard to them was obtained.

STICKS FOR BEATING TIME

At dances the men sometimes beat time with two short sticks. One of the sticks is held in the palm of the left hand and tapped with the other, held in the right hand.

XYLOPHONE

According to Handy, the natives of Nuku Hiva used an instrument called *pahu kou hau* which consisted of ten flat pieces of hau wood resting upon two slender transverse sticks. It was beaten with two sticks held in the hands. This instrument was evidently a primitive xylophone and, if aboriginal, is of considerable interest.

COMPARISON

Two quite distinct types of large drum were used in Polynesia. In Hawaii, the Marquesas, the Society and Cook islands, the drums were tubular, with a skin head, and stood on end; most of them were provided with a pierced base cut in one piece with the body. They were beaten with the hand. In Samoa and Tonga, on the other hand, the large drums were canoe shaped, closed at the ends, but with a long opening on one side. They were laid on the side, and were beaten with short clubs. In New Zealand, where one might expect to find the tubular, skin headed drum, the drum was of western Polynesian type. The great wooden gongs of New Zealand appear to have no Polynesian parallel. The large tubular drum is unknown in Melanesia, although the principle of this drum is used in small hand instruments. The long slotted drum on the other hand is almost universal. It seems possible, therefore, that the use of the long slotted drum in Samoa and Tonga is due to Fijian influence.

Wooden trumpets appear to have been used in only two Polynesian localities, the Marquesas and New Zealand. The instruments from these regions have little more than the principle in common, however, the Maori examples being much more elaborate. The wooden trumpet does not seem to have been used in Micronesia, and its Melanesian occurrence is limited to a single locality; the interior of northern New Guinea on the Sepik River.

Shell trumpets were used everywhere in Polynesia. In Hawaii the trumpet was made from a species of *Cassis*, in the Marquesas of both the *Cassis* and *Triton*, and in the Society Islands and New Zealand from the *Triton*. A separate mouth piece was used in the Marquesas, the Society Islands and New Zealand. In Melanesia trumpets made from the *Triton* shell are almost universal, and a species of *Cassis* is used in a few localities, but separate mouth pieces appear to be unknown.

The nose flute appears to have been used everywhere in Polynesia except Samoa. Mouth flutes, on the other hand, are found everywhere except in Hawaii, although Krämer believes their presence in Samoa to be due to Fijian or Tongan influence. Cook noted a tunable nose flute in the Society Islands. In Melanesia the nose flute is found in Fiji and in one or two other localities, but

it is not common. Mouth flutes are rare in Melanesia, but a type with two holes was used in New Caledonia.

Whistles were used in the Marquesas and in New Zealand. They do not seem to have been used elsewhere in Polynesia.

A Jew's harp practically identical with that found in the Marquesas was used in Hawaii, while a crude form of this instrument also is found in New Zealand. It does not seem to have been used in Western Polynesia. In Melanesia the Jew's harp is important only in the Solomon Islands, but the instrument used there differs so radically from the Marquesan, both in form and method of playing, that relationship seems improbable.

The occurrence of the musical bow in Polynesia seems to have been limited to the Marquesas and Hawaii. The Hawaiian instrument, *ukeke* (Emerson, 72, p. 147), had three strings, and it is possible that the Marquesan "lyres" bore some relation to it. In Melanesia a single stringed musical bow, which was tapped with a stick as in the Marquesas, was used in New Caledonia. A two-stringed bow, quite different in principle from the Hawaiian *ukeke*, was used in the Solomon Islands.

A joint of bamboo slotted along one side, laid on the ground and beaten with two sticks, was used as a musical instrument in Tonga, the Cook Islands and the Society Islands, but was not used in Hawaii or the Marquesas and is naturally lacking in New Zealand. In Melanesia it seems to have been limited to the south coast of New Guinea.

The use of a series of joints of bamboo which were held vertically and beaten upon the ground seems to have been limited, in Polynesia, to Samoa and Tonga. A curious drum made from several joints of bamboo lashed together, the heads covered with matting, seems to have been limited to Samoa. In Polynesia pan pipes of bamboo were limited to Tonga.

Although the distinction between the marginal and western divisions of Polynesian culture is less clearly marked by musical instruments than by houses or stone artifacts, it is possible to distinguish a few features. The large cylindrical drum with a skin head is an element of the eastern or marginal culture; the slotted drum is distinctively western. The reversal of this rule in New Zealand does not seem enough to invalidate the general conclusion. The Jew's harp also appears to be an element of the marginal culture. The wooden trumpet and whistle are limited to New Zealand and the Marquesas. In view of the absence of the nose flute in Samoa it seems possible that this also was originally a feature of the marginal culture and that its presence in Tonga is due to the strong Fijian influence. The slotted bamboo, on the other hand, and the series of joints of bamboo thumped on the ground, appear to be features of the western culture.

CLOTHING AND ORNAMENTS

The climate of the Marquesas is such that clothing is unnecessary as a protection from the cold. The original native dress was a scant costume of tapa. Mats seem also to have been worn but their use was exceptional. The only mention of this custom is by Krusenstern (34, p. 156) who, speaking of the people of Nuku Hiva, says,

Mats are sometimes used among them, and the king's son-in-law, though indeed he was the only person, always came to the ship in one of a very coarse kind, and fastened under the chin in such a manner as to merely cover the back.

In Hiva Oa the natives seem to have no memory of the use of mats as clothing and in view of the tapu which existed on that island against the use by men of mats other than those made of coconut, it seems doubtful that they ever were worn. This tapu was so strong that in former times straw hats which were considered a kind of mat could not be placed on the head without sacrilege.

TAPA

Tapa was made from the bark of several different trees. The most important is the *ute* or paper mulberry (*Broussonetia papyrifera* or *Morus papyrifera*) which yielded a soft white tapa. An inferior greyish tapa was made from the bark of the breadfruit tree, and a strong, mahogany colored tapa, much used in ceremonial costumes, was made from the bark of a species of banyan (*Ficus Sp.*). Jardin (33, pp. 32-59) says that the bark of the *mio* (*Thespesia populnea*) and the *katea* (*Alyxia*) were also used to a small extent.

The paper mulberry was essentially a cultivated plant, and was probably introduced by the early settlers. It was planted in fenced enclosures and carefully tended. The breadfruit and banyan do not seem to have been grown specially for tapa making, the bark being obtained from shoots and small limbs. A special form of *ute* tapa, made from the bark of an old tree, was worn as part of a priest's ceremonial costume.

IMPLEMENTS USED IN MAKING TAPA

The implements used by the Marquesans in making tapa were scrapers, beaters and anvils.

SCRAPERS

The scrapers used in the manufacture of tapa were made from pearl shells, rarely more than four inches across, whose edges were ground sharp. In some scrapers the irregularities of the hinge were also ground away to make the implement more convenient to hold, but the natural outlines of the shell seem always to have been retained. They must have formerly been very numer-

ous, for fragments of scrapers may be found in the earth of any village site. A few stone scrapers designed for other purposes may also have been used in tapa making.

BEATERS

The tapa beaters in common use were of two distinct types, the round and the square. There was a third rare type which was intermediate between the two main forms.

The round beaters (Pl. LXXIV, *A*, 3) are simple billets of *fau* wood, 18 to 20 inches long, cut from saplings $1\frac{1}{2}$ to $2\frac{1}{4}$ inches in diameter. These billets were stripped of bark, and while still green and soft, were incised from end to end with a number of closely spaced grooves made, it is said, with the corner of a stone adz. They were then allowed to dry, and were ready for use. Beaters of this type have no distinct handles and both ends and all sides may be used. The round beaters were commonly used only for the initial beating of the bark, but could be employed for the entire process of manufacture. A very fine piece of *ute* tapa was seen that had been beaten throughout with an implement of this sort.

The square tapa beaters (Pl. LXXIV, *A*, 1) were made of *toa* wood (*Casuarina*) and their manufacture must have required considerable skill and patience. Their handles are said to have been shaped with shells and the grooves cut with sharpened pearl shells or rats' teeth. Beaters of this type were common to the whole of Polynesia, but those from the Marquesas are easily distinguishable by their shorter and heavier grips. The body of the beater is rectangular; the grip is round and nearly as thick as the body. There is a slight flare at the butt of some beaters. Each of the faces is incised with a number of closely spaced longitudinal grooves. The number of grooves on the different faces of a beater varies slightly, but there seems to be no distinction of coarse and fine faces such as is found in the Tahitian and some other beaters. The ornamental designs on beaters which gave the tapa a sort of "water mark," common in Hawaii, seem to have been entirely absent in the Marquesas. A beater with a long slender grip, reminiscent of the Hawaiian and Tahitian forms, was seen in Hiva Oa, and another obtained from an old *mc'ae* on the same island, has the grip set at a slight but distinct angle to the body of the beater, a very unusual feature.

Beaters of the third type constitute an ancient form. (See Pl. LXXIV, *A*, 2.) Only two were seen, both of them crudely made. They are made of *toa* wood, are rectangular in cross section, but somewhat more slender than the ordinary square beaters and have no distinct handles. All four faces are grooved for their entire length, but the grooves appear to have been drawn alternately from

opposite ends, as some of them overlap slightly in the center of the implement. It seems probable that this form is a hybrid, combining the continuous grooves of the round beaters with the flat surfaces of the square type.

TAPA ANVILS

The Marquesans employed anvils of both stone and wood. Stone anvils are now little used, but in former times they appear to have been part of the equipment of every household. In early times they were used for only the preliminary beating, but later were occasionally employed for the entire manufacture.

In its simplest form the stone anvil is nothing more than a large flat water-worn boulder, but most anvils seen have been carefully worked from large blocks of stone. They are rectangular, with a length of from 18 inches to 2 feet, 6 inches; a width of from 8 inches to one foot, and a thickness from 4 to 7 inches. The tops have been carefully flattened and smoothed, the sides made vertical or nearly so. The bottom is usually left rough. Some anvils are widest in the middle, tapering evenly toward either end. An especially fine specimen from Pua Ma'u, Hiva Oa (Pl. LXXIV, *B*) has a longitudinal groove along either side for a short distance below the top and is remarkable in having the bottom more or less hollowed—a feature which may have resulted from its use as a whetstone for stone adzes. These carefully made stone anvils are of considerable interest, as they do not seem to have been used in any other part of Oceania.

Wooden anvils are still used in the manufacture of tapa. The only one seen was made of breadfruit wood, rectangular in cross section, and was approximately two feet long, ten inches wide, and six inches thick. This anvil differs in form from those described by aged informants, and possibly is of a modern and degenerate type. In former times two types of wooden anvils appear to have been employed. The simpler of these was a long straight log, preferably of breadfruit wood, smoothed but not otherwise prepared. The more elaborate type was made from a light colored wood, possibly a species of sandal wood, obtained on the plateau. It was U-shaped in cross section, with straight ends. Its hollowed interior made it more easily portable and increased its resonance so that the sound of cloth beating could be heard for a long distance.

TAPA MAKING

The paper mulberry, from whose bark the best grade of tapa was made, was raised in regular plantations. Handy was informed that dead trees 18 to 20 feet high were cut down and stripped of their bark, that the bark was then soaked, and finally beaten to remove the inner skin. A local informant said that live shoots 10 to 12 feet high were cut and barked while still green, and described the process of tapa making as follows:

The fresh bark was taken to a stream, where the coarse outer bark was removed with a shell scraper. The bark was not soaked before the initial beating, a point which was stressed by the informant who was familiar with both the Hawaiian and Marquesan processes of tapa making. The bark was beaten on a stone anvil with a round beater until it was similar to

paper pulp and in this condition it was very easily injured. This pulp was then wrapped in very large leaves (apparently from a species of *Caladium*) and taken into the house, where it was kept for two or three days. There was no fixed period for this storage, the time depending upon the condition of the pulp. After this "ripening" the pulp was beaten again with a square beater on a wooden anvil, rinsed in fresh water, and spread out to dry, the edges weighted with stones. The finished tapa was made up in large bundles which were hung from the ridge pole of the house until needed. (See Pl. LXXIV, C.)

A slightly different method of making tapa from breadfruit bark is described in a manuscript translated by Handy.

This account states that the bark was cut with a stone knife, peeled from the branches of a living tree with the teeth, beaten on a stone anvil for a long time, crushed and worked in fresh water, and done up in bundles to ripen. After ripening for four days, the pulp was beaten again on a stone anvil and finally on a wooden anvil.

An informant of Nuka Hiva said that in the final stages of manufacture layers of mulberry and breadfruit bark were frequently laid upon one another and beaten into a single piece, the upper side of which would be of one material, the other side of another. Used tapa was sometimes rebeaten.

Some of the tapa collected has evidently been oiled, although it is not certain that this was done with the intention of making it waterproof. The Bishop Museum possesses a tapa, ascribed to the Marquesas, one side of which is covered with a dark red glaze, but as there is no other evidence that this process was used in the Marquesas the specimen probably is improperly ascribed. Much white tapa was dyed yellow with a solution of saffron. Jardin (33) says he was told that the natives extracted a blue dye from the leaves of a species of *Cordia*, and adds: "I have never seen this practice and I have never seen their cloth dyed that color."

An interesting feature of Marquesan tapa is the use of the watermark of the ordinary grooved beater to produce ornamental effects. One specimen has been beaten with such skill that at first glance it appears to be cloth woven with heavy weft and light warp threads. The ridges and grooves made by the beater extend across it in continuous lines except for a narrow strip along either edge, which is beaten at right angles to the body of the piece, giving the appearance of a border. Another specimen seems to have been beaten with alternate strokes from right and left so that the watermarks cross each other and produce a series of small diamonds. Designs were never painted on Marquesan tapa.

The importance of tapa making in the life of the Marquesans is indicated by the many terms in use. The following have been taken from Dordillon's Dictionary:

- Akatea. Kind of bush for tapa.
 Akatotoo. Kind of mulberry tree for paper.
 Atea. Tree whose bark was used to make cloth.
 Hiapo. Young branch of the Banyan, whose bark is used to make cloth, also the cloth made from this bark.
 Ike. Tapa beater.
 Kokuu. Mallet of wood of this tree (Lily of India).
 Kotapa. To even the edges of cloth.
 Mapu. Native cloth.
 Mata. The right side of pretty cloth.
 Nie i te tapa. To equalize the edges of cloth. To cut off the unevenness.
 Pahito. Coarsely beaten tapa.
 Pahito hitohito. Coarsely beaten tapa.
 Pahoa. To beat bark for cloth.
 Papo i te tapa. To remake used tapa as new.
 Pataka. To peel wood, knocking underneath with a stone or other object.
 Peka i te tapa. To beat cloth in cross construction.
 Taemani. Said of lustrous, luminous cloth.
 Tahotahoki. To beat cloth slowly so that it will be closed.
 Tapa kokokoko. Native cloth.
 Tapa kookoo. Cloth.
 Tapa pia. Clear cloth.
 Tapa pokuu. Cloth made from breadfruit bark.
 Tihoo. To stretch (a cloth) in beating it, to make it larger and finer.
 Tipa. To beat a cloth for the first time.
 Titaa. Kind of beater of iron wood.
 Titapa. To even the borders of cloth.
 Tivaka. To put a length (leaf) in cloth.
 Tuaka. Cloth coarsely beaten.
 Tapa Tuakahikahi. Clear, thin cloth.
 Tumekaka. Cloth poorly beaten.
 Tutua. Wood on which tapa is beaten.
 Tututini. To rebeat a cloth many times to renovate it.
 Ute. A species of tree (*Morus papyrifera*). Bark for tapa. Tapa.
 E tapa vakavaka. Strong cloth serving for wrapping.
 Uuka. To make cloth into a bundle.

CLOTHING AND BODY DECORATIONS

The Marquesans rarely went entirely nude although, among the men at least, the practice was not unknown. Quiros (51) says that the first men seen by the Spaniards were nude and Krusenstern (34, pp. 156-159) is specific on this point. He says:

Even this girdle (the *hami*) is not worn by all the Nukahiwiers, for the handsome Mau-ha-u for instance, always effected to go naked; and, although on two occasions I presented him with a girdle, he came on board the next time without it.

Even when entirely nude the Marquesan sense of modesty required that the head of the penis should be covered. The foreskin, which was slit but not removed in the native form of circumcision, was drawn over it and confined by a ligature.

GARMENTS

The simplest form of clothing consisted of a few fau leaves wrapped around the genitals. This was employed by men when working on plantations at some distance from the village. The ordinary male garments were the *hami*, or loin cloth, and the cloak, both made of tapa. The cloak was usually dispensed with when at work. The ordinary *hami* consisted of a single strip of tapa approximately 2 feet wide and 8 feet long which was put on as follows: One end of the strip was passed between the legs, leaving a tail about 18 inches long in front. The rear end was then carried up and around the body to the right, and attached to itself by a few twists in the rear. The front tail was thrust up under the girdle thus formed, its end hanging down on the outside like a short apron. This simple *hami* was amplified in various ways on dress occasions. The commonest modification seems to have been the addition of a tail tied into large knots at equal intervals and long enough to drag on the ground behind. Handy obtained descriptions of two variations: the *hami kohito*, worn by old men, had three pendant strips in front, and a single tail behind; the *hami tatataka* had tails at the sides.

The cloak was made from a large rectangular piece of tapa with its upper corners knotted together. The knot was considered ornamental and was as large as a man's fist. The men's cloak was usually worn with the knot in front, on the breast, so that only the back of the body was covered. When in position its lower edges fell below the knee.

The complete clothing for women consisted of a loin cloth, apparently identical in arrangement with the ordinary man's *hami*, or of a kilt, made from a strip of tapa wrapped several times around the waist and reaching to the knee. A cloak was also worn. Stewart (59, p. 255) says that the younger women frequently wore only the cloak, which was wrapped around the body, the edges held together with the hand. The woman's cloak was identical with that of the men, but might

be worn with the knot either on the breast or on one shoulder. According to Handy the festive dress of the women consisted of a strip of tapa as much as thirty or forty meters long which was wrapped round and round the wearer, giving an effect not unlike an European hoop skirt. In some cases it was doubled and plaited around a hoop which hung from the hips. This custom of wearing great quantities of tapa has also been described from Hawaii and the Society Islands. It is rather interesting that the poncho-like upper garment worn in the Society Islands seems to have been unknown in the Marquesas.

TATTOOING

The Marquesans surpassed all other Polynesians in the excellence and extent of their tattooing. In men the entire person, even to the crown of the head, was covered with intricate and beautiful designs. Women were tattooed on the arms, legs and shoulders, but not on the body. The facial tattooing of women was limited to a series of short lines on the lips and a small figure behind the lobe of the ear. The present natives deny that the genitals were tattooed, but a drawing in the prospectus of Von den Steinen's book on Marquesan art indicates that this was sometimes done on women.

The tattooing was done with bone combs.

The larger combs were made from the bones of revenge victims, *heana*, the smaller combs of bird bones. In Hiva Oa at least smaller tattooing combs were made from the bones of tapu birds caught on Fatu Huku. The combs are roughly triangular in outline, with rounded apexes and slightly convex edges. Unfinished specimens show that they were shaped and ground to a sharp edge before the teeth were cut. The cutting of the teeth is said to have been done with a sliver of bamboo. The largest comb collected is about 3 inches long and $\frac{1}{2}$ inch wide at the base, with a maximum width of about $\frac{1}{2}$ inch, and a thickness of $\frac{1}{16}$ th of an inch. The smallest, made of bird bone, is about $2\frac{1}{2}$ inches long, with a base width of $\frac{1}{10}$ of an inch and a maximum width of about $\frac{1}{5}$ of an inch. The teeth range in length from $\frac{1}{8}$ to $\frac{1}{5}$ of an inch and vary in number from 3 to 18, according to the width of the comb. The lower edge of several of the combs is convex rather than straight so that the incisions made must have been deepest in the middle. This is not a constant feature and was probably accidental. The larger combs were used to fill solid space in the designs, the smaller, in working out curves and details. (See Pl. LXXV, A, 2.)

According to informants in Hiva Oa, the combs were provided with temporary handles made from joints of upland reed, in which small transverse slots were cut for the insertion of the upper end of the comb. When not in use the handles were discarded and the combs stored in short joints of bamboo (Pl. LXXV, A, 3). The complete implement looked like a miniature adz from four to six inches long. In Nuka Hiva a more permanent form of handle seems to have been used, the blade being attached by ornamental lashings of very thin sennit.

The pigment used in tattooing was made from soot or from pulverized charcoal, mixed with water to form a thick ink.

In making the soot pigment, which was considered the best, a flat water-worn stone was propped up on three other stones in such a way as to leave a small space beneath it. Three strings of candle nuts, strung on sennit, were then tied together in a bunch, lit, and thrust under

the flat stone. There were twenty nuts in each string, although the reason for this was unknown to the informant. The soot which collected on the under side of the flat stone was scraped off and packed in a small coconut shell (Pl. LXXV, A, 1). To make the charcoal pigment, coconut charcoal was pulverized with a small stone pounder. For this purpose smooth circular pits, common in large stones near villages, are said by natives to have been used as mortars. These pits are so numerous, however, that they must have been used for other purposes as well.

In tattooing, the mounted comb was held in the right hand, and a tapping stick of *toa* wood, about one foot long, in the left. A tapa rag was wrapped around the last two fingers of the right hand. The designs to be tattooed were usually drawn on the body in charcoal, but the most experienced artists frequently worked free hand. The comb was dipped in the ink and driven into the skin by a sharp blow from the tapping stick, the coloring matter running down the teeth into the wound. After each stroke the blood was wiped away with the rag.

The body was tattooed in sections, three days being allowed between operations for the healing of the wound. The texture of the skin does not seem to have been greatly altered by the operation, and flesh carving of the sort done by the Maori was unknown. The process was a long and painful one.

The many social and ceremonial observances connected with the tattooing of men, and especially of chiefs' sons, are described by Handy (32). A discussion of the practice of tattooing and of the designs used has been published by Willowdean C. Handy (32 a).

MUTILATIONS

The bodily mutilations practiced by the Marquesans were circumcision (32), the piercing of the ears and depilation.

The natives of both sexes pierced the ears for the attachment of ornaments. The operation was performed with a special awl-like instrument. The favorite material for these instruments was human bone, but bird bone and even tortoise shell were sometimes used. Practically all ear piercers were carved at the upper end, the decorations consisting for the most part of conventionalized human faces or figures. (See Pl. LXXV, B.) Many specimens have a loop of sennit permanently attached to the upper end, while almost all are drilled for suspension. Such piercers were treasured in families as heirlooms, but seem to have no religious significance.

The ear aperture was somewhat larger than in pierced European ears, being $\frac{1}{4}$ to $\frac{1}{2}$ of an inch in diameter, but dilation of the ear lobe does not seem to have been practiced. Some of the men's ear ornaments strongly suggest ear plugs, however, and it is possible that dilation of the ear lobe, common in Melanesia, was at one time practiced in the Marquesas. If so, it had become obsolete before the historic period, as it is not mentioned by any of the early writers.

Both sexes removed the pubic and axillary hair by means of tweezers made from the shells of small bivalves.

HAIR DRESSING

A number of modes of hair dressing were employed by the Marquesans, the men apparently surpassing the women in the number of styles. Porter says:

The females at times, on what occasions I do not know, shave their heads close; but I am induced to believe that such occasions are rare, as some wear their hair long, some cut short, and some cropped close, while others are close shaved. They have such variety in wearing their hair that I could not discover any fashion which seemed to prevail over the others. (See 49, pp. 113-114.)

The *pahhe* (woman's head dress) consists of a remarkably fine and white piece of paper cloth, of open texture, and much resembles a species of fine gauze, called by us spider's web. This is put on in a very neat and tasty manner and greatly resembles a close cap. The hair is put up gracefully in a knot behind, and the head, when dressed in this manner, bears no slight resemblance to the prevailing fashion of the present day (1812) in America. (See 49, p. 96.)

Porter's observations were made in Nuku Hiva. According to informants in Hiva Oa, women's hair was usually cut off at the shoulders, although it might be allowed to grow full length. On ordinary occasions it was allowed to float free, or was held back from the face by a band of white tapa, with the ends hanging behind. At the time of feasts the hair was drawn up through the *pachaka*, or other ornament worn, and frizzled so that it stood out in small locks. One informant said that these locks were sometimes passed through small corrugated tubes of human bone, of the sort used to decorate container handles.

Men shaved their heads in various ways. Porter says (49, pp. 113-114):

Their [young men's] custom is to put it up in two knots, one on each side of the head, and they are secured with white strips of cloth, with a degree of neatness and taste which might defy the art of our best hair dressers to equal. The old men wear it sometimes cut short, sometimes the head is shaved, and they occasionally have their heads entirely shaved, except one lock on the crown which is worn loose or put up in a knot. But this latter mode of wearing the hair is only adopted by them when they have a solemn vow, as to revenge the death of a near relative, etc.

When the hair was dressed with two knots the center and back of the head was shaved, the tapa wrapped knots protruding like horns from the bare skull. Gracia (28, p. 134) says that the old men, and especially the high chiefs, wore their hair done up in a single horn on top of the head.

The natives of Hiva Oa seem to have had an even greater variety of styles. Some men never cut their hair, others did it up in two horns, as in Nuku Hiva; still others arranged the crown in fantastic ways, as one half shaved the other long, or the front shaved and the back long, or a series of shaved stripes, with long hair between. Handy was informed that in time of war, finger bones or other trophies of slain enemies were attached to the hair.

In pre-European times the head was shaved with a shark's tooth, the hair being gathered in small bunches and the tooth sawn back and forth across it at the roots. Porter (49, p. 114) says that the hair was sometimes singed off with a fire brand. As it was important that the cuttings of the hair should not fall into the hands of an enemy who might use them for malevolent magic, the hair was usually cut in the bed of a stream or on the sea shore. In Atu Ona, Hiva Oa, it was customary for the relatives of a man killed in war to let their hair grow until accounts were squared by the capture of one of the enemy. Their hair was then cut at the public assembly place, the clippings being thrown into a special pit.

Many of the Marquesan men are naturally rather heavily bearded, but practically all are clean shaven or wear only a moustache. A number of methods of arranging the beard were formerly in vogue. Krusenstern (34, pp. 158-159) says the natives of Nuku Hiva usually shaved off their beards except for a small tuft on the chin. In describing the natives of the southern islands of the Marquesas group Fleurieu (23, p. 113) says:

Those who wear their beards full length, and these are the greatest number, arrange them in different ways. The commonest is to part the beard in two tufts, shaving or plucking the chin, and letting the beard grow on either side. Many others let it all grow and separate it into locks, which they plait, or to which they attach the teeth of fish, human teeth, little pieces of bone, shells, or the colored glass beads which they get from Europeans. Some do not let the middle part grow. Finally, others shave it entirely.

According to Handy the men usually plucked the beard, but many old men would let it grow in order to obtain hair for *pavahina*, ornaments worn on the head. This was usually done for the benefit of some relative, but a man wishing to make a *pavahina* might pay an old man to let his beard grow for the purpose.

Both men and women kept the hair liberally anointed with scented oil (*pani*).

The oil was obtained by scraping the flesh of an old coconut, wringing it out in a cloth, and adding chopped-up *tiarc* flowers and sandal wood, grated by rubbing a piece of the wood, preferably the root, with a rasp made from the tail of the giant ray. The mixture was stirred until the flowers had absorbed all the oil and then left in the sun for three or four days until the oil separated once more. The oil was then drained off and kept in a bamboo, a *fau* leaf being tied over the open end. Before use, it was diluted with plain coconut oil.

Langsdorff (38, p. 175) describes a somewhat different method of making coconut oil, although it is evident that he refers to the plain oil and not to *pani*. He says:

They scrape the kernels of a great number of coconuts, which they put upon banana leaves, and let it lie out in the sun for four or five days. They then press the oil from an equal number of fresh coconuts over the scrapings, and let it lie in the sun again for two or three days; by repeating this several times, a quantity of good oil is procured. It is kept for use in the hollow of bamboo canes.

Pani was used only on the hair, the body being anointed with *pao panu*, coconut oil scented with sandalwood.

BODY PAINTING

Persons of both sexes painted the entire body yellow, but the use of other colors, or of painted designs, seems to have been unknown. The principal source of the pigment was the root of the turmeric which was cultivated for this purpose. In Hiva Oa this is called *ena*, but Dordillon gives the word *kotohi*, which he translates as "root of turmeric which is planted." The turmeric root was dried, grated, and mixed with coconut oil to form the paint. The natives still stain their faces and hands with the fresh root as a protection against insects. Several other plants seem to have been used for body painting, all of which yielded a yellow dye. Langsdorff (38, p. 114) also says that in Nuku Hiva both sexes painted themselves with the sap of *Thespesia populnea* mixed with coconut oil. Jardin (33, pp. 32-59) says that the juice of *Sinapis nigra* was used to stain the body. He also says that a much prized yellow dye, used for both body painting and tapa dyeing, was obtained from a species of amomum (*Curcuma longa*) which grew in a single locality—a place called Muake in the interior of Nuku Hiva. The roots of this plant were prepared by a secret process and the dye was sold in powdered form. The name which Jardin gives for this plant, *eka*, is the Nuku Hivan equivalent of the Hiva Oan word *ena*, but it seems certain that the *eka* root of Nuku Hiva was not the turmeric (*ena*). It was probably this substance which was an article of trade in ancient times, and which was so highly prized by the natives of Hiva Oa that they sent two large canoes to Nuku Hiva in exchange for it.

SKIN BLEACHING

White skin was greatly admired by the Marquesans, and it is mentioned as a beauty feature in some of their legends. They had discovered a process for temporarily bleaching the skin, so that immediately after treatment they were almost as light as southern Europeans. The earliest account of the process is given by Langsdorff (38 pp. 113-114), who says:

The manner in which it [bleaching] is done is to rub the whole body with sap extracted from the leaves of three different plants called here *epapha*, *hoko-kuh* and *ohue*. The skin becomes at first entirely black, and for four or five days the person undergoing the operation cannot leave the house; they then wash themselves well with fresh water which takes off the black sap and leaves the skin its natural, nearly white color.

The account obtained by Handy differs somewhat from this. The body, and especially the face, was first painted with *ena* and coconut oil. Over this was smeared the juice from the crushed leaves of the *kokuu* tree or *papa* vine. This gave the skin a green color. The person undergoing the operation stayed in the

house for seven or eight days, at the end of which time the skin was bleached. Jardin (33, pp. 32-59) says the natives of Nuku Hiva used the sap of the *niou* (*Siegesbeckia orientalis*) as a skin bleach, rubbing the skin with the crushed leaves the day before a fête.

Skin bleaching seems to have been almost confined to the women, although Stewart (59, pp. 259-260) mentions a male dancer, whose skin had been bleached in this way, who was "almost as fair as any one of our number." The light color produced in this way lasted for only a short time, exposure to the sun causing the skin to reassume its normal brown tint.

SPECIAL COSTUMES

Special costumes were worn by priests in the performance of their duties. According to Handy the ceremonial dress of the *ta'ua* of Atu Ona, Hiva Oa, was a full length robe of tapa made from the thick bark of old banyan trees. It covered the whole body and came to the ground, and was likened by the natives to a priest's cassock. It was called *kahu kohito*.

Stewart, writing of Nuku Hiva, says (59, pp. 271-272):

The Tahunas have a distinctive dress, consisting of a cap formed from a coconut leaf. A part of the stem, six to eight inches in length, is placed perpendicularly over the forehead, and the leaflets still attached to it are passed around the head on each side and neatly fastened together behind. Besides this article on the head, they wear a cape of the same material. In this the stem is split till within an inch or two of one of the ends: it is then passed around the neck so that the extremities rest on each shoulder, and the separated ends are tied together. The ribs running through the leaflets being taken out, they hang gracefully over the chest and back. These articles are usually worn by them on ordinary occasions, and always when in discharge of the services connected with their office.

He describes the dress of a *ta'ua* whom he visited as follows (59, p. 328):

His whole figure was enveloped in a large mantle of snow white tapa, or native cloth, over which a smaller one of fine scarlet kerseymeré fell from his shoulders down the back—both being fastened by one large knot, resting on the chest in front. A double roll of fine white tapa encircled his forehead; while his hair, tied in two close knots, was confined on the crown by long bands of the same.

According to Handy the *taputoho* at Pua Ma'u, Hiva Oa, wore a long cloak of *ute* tapa, like a blanket, which was called *kahu kookoo*, and a peculiar dark colored headdress called *pae kohito*. This headdress was made from the bark of an old *ute* tree which was slightly pounded, and left rough. It was tied around the head and knotted behind with a piece hanging down.

Stewart (59, p. 288) describes the dress of a messenger bearing invitations to a funeral as follows:

[He] was dressed in a large quantity of white cloth, wearing on his head a bandeau of white with bows, surmounted by a miter shaped cap, formed of the green leaf of a banana

tree. Besides the fan in his hand, he bore on his shoulder a long pole from which were suspended seven white scarfs, tied into bows at the ends, in a manner similar to those used in our own country.

Stewart describes also the dress of two boys who performed at a fête which he attended (59, pp. 259-260):

One wore on his head the feather helmet and other decorations of the ear and neck of a warrior—the cap being of equal height to all the rest of his figure. About his girdle was a full sash of white cloth tied in a large bow with long ends in front; and from it four white cords of plaited tapa, two behind and two before, descended to the knee—each terminating in monstrous tassels of black hair, fastened to flat circular pieces of wood, whitened with pipe clay. His waist, wrists, and ankles were also hung with the same, and in either hand he held a small tuft of white.

The headdress of the other was a bandeau of white cloth, in a thick roll over the forehead; and above this a wreath of black feathers, surmounted by a high ornament of white tapa gathered into folds at the frontlet, and spreading above into a large cockade in the shape of a peacock's tail—the whole having an airy and tasteful appearance. His necklace was composed of alternate bunches of a brightly shining aromatic vine, and the flowers of the cape jessamine; while his maro, of the purest white, arranged in neat folds, was intertwined with garlands of the same.

Langsdorff (38, p. 172) says that women used green boughs or banana leaves as parasols. Fleuriu states (23, p. 116): "One should count also among their ornaments . . . parasols made of large palm leaves, which they ornament with feathers of different sizes and colors." None of these parasols have survived.

ORNAMENTS

The Marquesans compensated for their simple costumes by the use of a great variety of ornaments, ranging from quickly made necklaces and wreaths of ferns and flowers to elaborate headdresses whose manufacture must have required months of work. Certain ornaments were worn exclusively by men or by women, but it is an interesting commentary on the position of the women that many of the most valuable could be worn by either sex. There are some indications of local differences in ornaments, but these are hard to establish at the present time.

FLOWERS, HERBS AND FRUITS

A great variety of wreaths and garlands, made from ferns and from all sorts of flowers and fragrant herbs, were formerly worn by the Marquesans. This sort of decoration is now limited to wreaths worn on the hair or around the hat.

Most of these wreaths are made from plants chosen for their odor rather than their beauty. The finest are made from *Guttarda speciosa* which bears a creamy yellow tubular flower of wonderful fragrance. The calyxes of the flowers are broken off and the tubes threaded upon a string, the base of one flower entering the mouth of the next. The flowers have a peculiar property of increasing in fragrance as they wither and even when dried have a pungent perfume. At the present time the flowers of *Gardenia tahitensis* are much used for wreaths, although this plant is not native to the Marquesas. The calyxes are broken off, but are left suspended by the pistil. The corollas are then threaded. The finished wreath is a white band from which hangs a fringe of bright green calyxes.

A necklace made from the fragrant ripe fruit of pandanus [*Pandanus odoratissimus*] was formerly a favorite ornament of both men and women.

The fruit looks somewhat like small sweet peppers, with shiny surfaces, bright red at the upper end, shading to lemon yellow at the tip. They were pierced laterally and strung side by side, small ends up, so that they formed a heavy semicircular collar two to three inches wide in the center, tapering toward either end. These ornaments are especially interesting because of their resemblance to a form of wooden gorget. (See p. 429.)

ORNAMENTS MADE OF HAIR

Ornaments made from locks of human hair attached to a band of coconut fiber are highly characteristic of the Marquesan culture; nothing at all resembling them seems to have been used elsewhere in Oceania. Although these ornaments vary in size according to the part of the body on which they were to be worn, the technique is always the same.

The band to which the locks were attached was composed of a number of strands of twisted coconut fiber, which were plaited around two heavy longitudinal cords. The method of plaiting was such that at first glance the band seemed to consist of two half-inch ropes, tightly twisted in opposite directions, and fastened side by side. (See Pl. LXXVI, A.) The hair was made up into a number of small locks which were attached to the

bands separately. These locks were made as follows: A long tress was wrapped at the center with a few turns of fine sennit. It was then doubled back upon itself, and the wrapping continued upward, so that the hair was enclosed in a fiber sleeve about half an inch long. The lock was thus reinforced with sennit at the inner end and terminated in a loop. The separate locks were attached to the band by means of strands of fiber which were separated from one of the cords of the plait, passed through the loop, and twisted into the cord again. The processes of twisting the cords, attaching the locks of hair, and plaiting the band must have been carried on simultaneously, an arrangement which called for a remarkable degree of skill on the part of the workman.

Hair ornaments were made by a special *tuhuna*, who also made feather-work. When an ornament was made for a child the hair was donated by its mother's brothers and father's sisters. For a chief's child all the men in the tribe contributed hair. According to Handy, the hair of revenge victims was also used. The hair was curled, apparently after it had been made up into locks, by wrapping it tightly around small sticks, doing these up in green leaves, and baking them in an earth oven.

Hair ornaments were worn by both men and women on festive occasions.

A complete costume consisted of a large shoulder ornament, one or two waist ornaments, bands on the wrists and above the elbow, and bands on the ankles and just below the knee. The shoulder ornament was worn like an European boa, the longest part resting in the middle of the back while the ends were tied together on the breast and held down by a whale's tooth or other ornament. The waist pieces were worn over the *hami* (loin cloth). When there was only one, it was placed in the rear, like a bustle, when two, one was worn in front and one behind. Plate LXXVI, *A* shows a shoulder ornament; *D*, a waist or shoulder ornament and *E*, a wrist band. The only knee ornament seen was of long wavy hair, like the waist ornament.

Handy gives the following native names for these ornaments: *titi ouoho*, shoulder ornament; *titi ouoho kei*, waist ornament; *poi ima*, arm ornaments; *motutu ouoho*, wrist ornaments; *poi vaivai*, leg ornaments.

BELTS AND ANKLE ORNAMENTS

Edge-Partington (20, p. 48) figures a belt of seven parallel rows of bird bone beads, strung on sennit. Some of the beads are decorated with diagonal incised lines.

In Hiva Oa, at least, bands of feather work were sometimes worn around the ankles in place of hair ornaments. No examples of these have been preserved and the information about them is unsatisfactory. They are said to have been made of short black roosters' feathers attached to a broad fiber band. To judge from other feather ornaments they were probably laid on overlapping and pasted to the base.

FINGER ORNAMENTS

Ornaments made from the long tail feathers of the tropic bird were worn by male and female dancers on the second finger of both hands. The ornament

was made by wrapping the lower ends of the feathers with sennit or inserting them in a short bone cylinder. A sennit loop attached to the ornament was slipped over the finger. (See Pl. LXXVI, C.) Dordillon translates the word *kihi* as "ornament of white bead for the fingers." True finger rings seem to have been unknown in ancient times.

BRACELETS AND ARM ORNAMENTS

The Marquesan shell bracelets are of considerable interest in view of the wide distribution of such ornaments in Melanesia and their comparative rarity in Polynesia. Two examples are shown on Plate LXXVI, B. The broader of these is made from the end of a large *Conus* shell of some sort and is rather crudely finished. The narrower has apparently been ground from *Tridacna* shell, and is unusually well made. As *Tridacna* shells of suitable size are lacking or at least very rare in the Marquesas it seems probable that this bracelet was an importation.

In the Peabody Museum at Salem are some very interesting wrist ornaments which were collected during the early nineteenth century. They are of types which have been forgotten by the present natives and the locality in which they were obtained is unknown. Two of these ornaments (Pl. LXXVI, F) are made from large blue black seeds, about the size of a small grape, which are attached to a band of plaited coconut fiber identical with that used for hair ornaments. Each seed is punctured at the stem end and attached to a cord of twisted fiber, which is held in place by a small wooden plug. The other ends of these cords are plaited into the band.

A still more showy wrist ornament is composed of strings of *Abrus precartorius* seeds. The fiber base is like that used in the ornaments just described, but the seeds are pierced and strung on loops of fine cord whose ends are woven into the band. (Pl. LXXVI, G.)

NECKLACES

Necklaces made of a great number of strands of braided human hair were formerly worn by men in the Marquesas. These necklaces, called by Dordillon *takionoho*, are rare, but there is a very fine specimen in the Peabody Museum at Cambridge and four less perfect ones are in the Peabody Museum at Salem. (See Pl. LXXVII, I, A.) In one specimen (2) the strands of hair seem to have run around the neck continuously; in the others the strands were made into a thick bundle with the ends wrapped with many turns of fine sennit or human hair string. One end of specimen No. 1 is wrapped in such a way that it forms a compact blunt point and the other end is finished with a sort of corrugated cylinder large enough to admit this point. When worn, the pointed end was evi-

dently thrust through the loop and held on the outside with a pin of some sort. Edge-Partington (20, p. 44) shows a specimen with ends finished in this way which has three shell pendants of graduated size. Necklaces with both ends finished alike were tied behind the neck with strings of twisted tapa. (See Nos. 3, 4.) A polished pearl shell was usually suspended from the center of the necklace.

Edge-Partington (20, p. 67) figures a hair girdle from Niue which closely resembles these Marquesan necklaces. A necklace of similar form from the Ellice Islands is now in the American Museum of Natural History, and the National Museum has a series of necklaces from Penrhyn Island which differ from the Marquesan forms only in minor details of the finishing of the ends. All these ornaments are obviously similar to the Hawaiian hair necklaces which with a whale ivory hook formed the insignia of chiefly rank.

Necklaces other than those of hair cord seem formerly to have been worn principally by women. They were made from porpoise teeth, shells, or seeds and in later times of European glass beads. The teeth used were perforated as near the bottom of the root as possible, and strung on threads of pineapple fiber. Bead necklaces were usually made of a double strand of beads which was looped back and forth as in chain stitching. The ends of the necklace were tied together at the back of the neck. Combinations of beads and teeth, or of beads and shells, seem to have been rather common. (See Pl. LXXVII, B.)

GORGETS AND BREAST ORNAMENTS

The Marquesans used a great variety of gorgets and breast ornaments, most, if not all, of which were worn by the men. The most valued of these was the *ei*, or whale's tooth (Pl. LXXVIII, A) some of which at least had a religious significance. As the Marquesans did not catch whales the supply of teeth must have been far below the demand. Porter says that a schooner load of sandal wood could be bought with ten large teeth. Whales' teeth worn as ornaments were drilled transversely near the tip of the root, and were commonly ground at this end, to make them thinner and easier to perforate. In view of their skill in ivory carving it is rather curious that the natives seem not to have carved or shaped these teeth. The tooth was sometimes attached to the ends of a hair ornament worn on the shoulders, serving to weight it down and hold it in position. Most of the specimens seen, however, were attached to ropes of twisted coconut fiber covered with white tapa.

Plaques of large pearl shells were formerly used in the Marquesas, but very few examples have survived.

In making the plaque the shell was ground to a more or less regular outline and the colored outer layers removed except for a narrow band around the edge. This band was dec-

orated with a series of closely spaced notches which in one specimen (Pl. LXXVIII, B) gives the edge of the shell a toothed appearance. Along the upper margin two or more holes for suspension were made. Shell plaques of this sort seem to have been intended primarily for wear with the necklaces of plaited hair.

Plaques ground from the large end of a species of *Conus* shell were also used as breast ornaments, but they seem to have been much less common than those of pearl shell.

These plaques were smoothly ground on both sides, the marks of the whorls being almost obliterated. A hole for suspension was drilled near one edge; a few plaques have two holes, drilled opposite each other. These plaques appear to have been worn suspended from necklaces, but no complete specimens were seen. Their occurrence in the Marquesas is of considerable ethnological interest as such ornaments are rare or lacking in other parts of Polynesia but are highly developed in Micronesia.

Two curious objects of featherwork, one in the Peabody Museum at Salem, the other in the Peabody Museum at Cambridge, are probably to be classed as gorgets. (See Pl. LXXXVIII, C, 1.)

These gorgets are made from glossy black cocks' feathers cut to length, those on the upper edge being quite short and those on the lower edge measuring three inches or more. The feathers are laid on in regular overlapping tiers, beginning at one end of the crescent. The exact method of attachment could not be determined, but the feathers seem to have been pasted to a pad of tapa or other soft material in rows and further reinforced by single strands of banana fiber wrapped around the base of each row. The suspension cords are of plaited fau bark. The attachment of the cord at one end is covered by the natural slope of the feathers; the other end is concealed by a sleeve of fine sennit decorated with human hair cord applied in a wrap weave. At the bottom of this sleeve are traces of a band of green and yellow feathers. The dimensions are: length across tips, $9\frac{1}{2}$ inches; maximum width, $2\frac{3}{4}$ inches; thickness, $1\frac{1}{4}$ inches.

An ornament of large seeds, now in the Peabody Museum at Cambridge, should probably be classed as a gorget, although its construction suggests that of the hair ornaments. The seeds are black and as large as grapes. They are perforated at the stem end and attached to cords of twisted coconut fiber by the method used for seed armlets. They differ, however, in having two seeds attached side by side to the end of each strand. These strands are attached to a band identical with that used in hair ornaments. To either end of this band are fastened long cords of twisted fau bark.

The most characteristic of the Marquesan breast ornaments are the large collars, or gorgets, made from light wood and encrusted with the seeds of the *Abrus precatorius*. One of relatively simple form is shown on Plate LXXVIII, C, 2. The base of this ornament is a crescent of soft light wood, cut in a single piece. One side of this crescent was coated with soft breadfruit gum, then covered with the shiny red and black *Abrus* seeds. Along either side of the encrusted space are glued flat ribbons plaited from strings of white tapa and blackened fau bark. The ends of these ribbons are plaited together to form the

cords for attachment. It is possible that this specimen is a head ornament rather than a gorget, as a somewhat similar ornament is said to have been worn with the great headdress of cocks' feathers.

Plate LXXVIII, C, Nos. 3 and 4, shows two gorgets of more ordinary type. They are composed of a number of sections of light wood strung together by cords running through lateral holes. The cords are concealed except at the ends, where they are braided together to form the tying strings. The usual number of cords seems to be two, but a gorget in the Cambridge Museum has three. Each section of the gorget has a thick inner end and a thin outer end, but the proportions of these parts are variable. In the specimens figured the outer ends are short and flat, but in other gorgets the ends are considerably longer than the thick portion and slope upward toward the outside so that the collar looks dished. In a few gorgets the edges of the collar are cut into tongues or rays. The assembled collars are so rigid as to indicate that the sections were glued together. The incrustation was limited to the thin outer part of the collar. The thick part was whitened with lime or clay.

It is rather curious that the Marquesans should have made a rigid collar of many sections when it would have been much easier to cut it in a single piece. The most plausible explanation for its composite construction seems to be that the idea was borrowed from the necklaces of pandanus fruit which had much the same shape. Krusenstern (34, 156-158) says such collars were the peculiar mark of a priest.

So far as known, seed incrustated ornaments are found only in Polynesia in the Marquesas and Cook Islands. Outside of Polynesia they appear to have been made only in Australia and northern New Guinea.

Necklaces and breast ornaments differing from any of those described are mentioned by some of the early visitors. Langsdorff (38, pp. 170-171) says:

"Hogs' fangs or pieces of bone, or muscle shells of a particular kind strung together in rows with the threads of the coconut, are very common as necklaces." Fleurieu (23, p. 114) says: "Some are content to carry, hanging from their necks, small pieces of polished bone, of shell, or of white coral or stone which are carved in different figures but which for the most part imitate a large tooth." He also remarks (p. 120) that the women wore collars or necklaces made of black seeds mixed with little shells. Desgraz (15, p. 283) says that small tiki figures of human bones were worn around the neck as amulets. Krusenstern (34, pp. 156-159) says:

"Another sort of gorget is made entirely of boars' teeth fastened onto a band, woven with the fibers of the coconut, and they also wear single boars' teeth, either suspended from their necks, or fastened to their beards, and balls about the size of an apple entirely covered with red beans."

A drawing reproduced by Cook (14, p. 310) shows a string gorget of unusual form, which seems to be made of a great number of short cords doubled over a longitudinal rope. The cords are gathered into bundles just below this rope, the ends hanging free in a deep fringe.

According to Handy (32) collars of pearl, called *pipici*, were sometimes placed with a body at burial, and three types of headdress, the *taavaha*, *packua*, and *hei kua* were sometimes worn around the neck or on the breast.

EAR ORNAMENTS FOR WOMEN

A pair of ear ornaments of rare type are illustrated in Plate LXXIX, *A*, 1, 3. The "S" shaped body of these ornaments is made of a narrow strip of tortoise shell which was softened by heat and bent into shape. At about a third of its length the strip is perforated for the attachment of an ornament composed of porpoise teeth and beads. The teeth are somewhat smaller than those usually used for crowns, but like them are strung on loops of coconut fiber. The beads are, of course, of European manufacture. The long projecting end of the strip was thrust through the lobe of the ear, the body of the ornament hanging below with the toothed portion to the rear. These ornaments were used by women.

The object shown on Plate LXXIX, *A*, 2, may be classed as a woman's ear ornament. Its construction is essentially the same as that of the ornaments just described, but the strip is replaced by a large black seed which has apparently been oiled and polished. The method of wearing this ornament is unknown, but it seems probable that the seed and bead tassel were worn in front of the ear with the teeth behind.

The commonest form of woman's ear ornament, called *taiana* is shown at the bottom of Plate LXXIX, *B*.

The *taiana* is made of two pieces, a cap and a body. The cap, called *puii*, is made from some white shell, probably *Tridacna*, and has on the inner side a cylindrical cavity about one-fourth of an inch deep. The sides of this cavity are lined with a thin layer of pith or soft wood. The body consists of a thin strip of human bone whose inner end is finished with a short cylindrical shank. The tip of this shank is cut to accurately fit the cavity in the cap. The rest of the body is decorated with highly conventionalized human figures. A large figure with extended arms is represented in profile at either end, and between these, two smaller figures, shown in front view. The heads of these small figures are supported by the hands of the end figures, while their legs appear at the bottom. Their bodies are not represented. The two ornaments shown at the top of the plate differ considerably from this normal type, but the basic concept is probably the same as the four heads are still recognizable. The inner sides of the ornaments are left rough. The elaborate piercing used in working out the designs is especially interesting as this technique seems not to have been employed in any other Marquesan objects. Ornaments of this sort were worn with carved portion projecting horizontally behind the ear, the cap, which was fitted on the shank, resting against the front of the ear lobe.

The bone of which they were made is said to have been obtained from dead relatives, not, as was the usual practice, from revenge victims. The figures represent ancestors, one of the large figures being male and the other female. Such ornaments were highly prized, and were inherited in the female line.

According to an informant in Fatu Hiva women sometimes wore ornaments similar to the *taiana*, but made from a boar's tusk instead of human bone. Early writers make little or no reference to women's ear ornaments, although they describe those of the men in considerable detail.

EAR ORNAMENTS FOR MEN

The most highly prized of the men's ear ornaments were the *ha'akai* (Dor-dillon, 17).

Ha'akai were made from whale ivory in the form of a thick disc from whose rear surface a spur projected. The disc portion was oval, with a flat or slightly rounded outer surface, and was undecorated except for two broad shallow grooves around the edge. The spur was placed near one end of the oval, and was usually made in one piece with the disc. In the specimen shown on the left (Plate LXXIX, C), the spur is made from a separate piece of ivory, its base fitting accurately into a cavity in the disc. It is held in place by small plugs of wood and ivory which pass through holes drilled diagonally through both disc and spur. The ends of these plugs are cut flush with the surface of the disc and it is evident that the attachment was permanent. One or two small tiki figures in high relief are carved on the sides of the spur, and in some plugs there is an additional figure at the tip. A hole, parallel to the long axis of the disc, was usually drilled through the spur near its base.

The ornaments were worn with the discs in front of the ear, the spurs passing through holes in the ear lobes and projecting behind. A small wooden plug, thrust through the hole near the base of the spur, kept the ornament in position. The weight of some discs was supported by a band which passed across the top of the head.

Several other types of men's ear ornaments are described by early writers. Stewart (59, pp. 248-249) says:

In their ears, and entirely concealing them, they wore ornaments of light wood whitened with pipe clay. They are perfectly flat in front, something in the shape of the natural ear, but much larger, and are fastened by running a long projection on the hind part through slits made in the ears for receiving such ornaments.

A portrait of a chief wearing ear ornaments of this type is shown by Cook (14, p. 306). In this figure the discs appear to be in the form of long ovals of rather irregular outline.

An object which probably formed part of an ear ornament of this general type was obtained from a burial cave in Hanamenu, Hiva Oa. It is an oval disc of light wood about $1\frac{3}{4}$ inches long, $1\frac{1}{2}$ inches wide, and $\frac{1}{4}$ of an inch thick. In the center there is a small perforation which may have served for the attachment of a spur. Both sides are smoothly finished, and the edge is cut in such a way as to leave a flange on what was probably the outer side.

Krusenstern (34, pp. 157-158) says of the natives of Nuku Hiva:

They adorn their ears with large white muscles of a circular form, filled with a hard substance like sand, to which a perforated boar's tusk is affixed for the purpose of fastening it to the ear; a small wooden plug passes through the tooth, serving as a clasp to prevent its falling out.

Langsdorff (38, pp. 170-171) says: "A muscle shell of an ounce weight, to which is fastened the fang of a hog somewhat polished, or a light oval piece of breadfruit wood, is the great ear ornament," and Fleurieu (23, p. 114) makes the observation that, "although both men and women have their ears pierced none were seen who habitually wore pendants."

EAR ORNAMENTS WORN BY MEN OR WOMEN

The pair of very simple ear ornaments shown on Plate LXXIX, *D* are made from heavy white shell, probably the lip of the *Tridacna*. One end is carved in imitation of the caps on women's ear ornaments of the *taiana* type. The remainder of the ornament is a simple spur, which, in one specimen, is perforated about midway between the base of the large end and the tip. It has been suggested that these objects were used to keep open freshly perforated holes in the ears.

A number of ear ornaments which appear to be intermediate between the *taiana* and *haakai* types have been preserved. Certain specimens in the American Museum of Natural History are shaped and carved like the spurs of the *haakai*, but are provided at the forward ends with shell caps identical with those used on the *taiana*. A specimen in the Peabody Museum of Harvard University resembles still more closely the spur of a *haakai*. It is made of whale ivory, and has a tiki figure in high relief carved on one side and two smaller figures on the tip. The inner end is blunt and irregular, but there are no indications that it has ever been attached to a disc. It was probably fitted with a shell cap. A specimen in the American Museum of Natural History seems to be a modification of the *haakai* type, but is made from shell. The forward end is worked into a disc considerably larger than the usual shell cap, while the spur is carved with a tiki figure in high relief.

COMPARISON

The only Marquesan ear ornament for which there is any parallel in the Pacific is that made from tortoise shell, porpoise teeth and beads. This ornament bears some slight resemblance to those worn on the Island of Yap, of which Furness (74, p. 62) says:

[This] ear ornament is a piece of thin tortoise shell, about a third of an inch wide, bent in the form of a "U"; this is hooked in the lobe of the ear and from the outer ends are suspended little strings of beads.

The more typical Marquesan ornaments of bone, shell and ivory are unlike those used in any other part of Oceania, and must be considered as a local development. The peculiar practice of placing the most highly decorated part of the ornament behind the ear, where it can be seen only on side view, is almost unique.

HEADRESSES

A great variety of headdresses were used by the Marquesans. In Nuku Hiva at least the most important of these appears to have been a crest of black cocks' plumes, called *taavaha* or *taavaha pepana* (Handy). A well preserved

ornament of this sort, now in the Peabody Museum of Salem, is shown on Plate LXXX, *A*, 2.

The ornament consists of two feathered bands, of identical construction, placed side by side and fastened together by wrappings of sennit at intervals of three or four inches. The ends of the bands are enclosed in a longer wrapping; each band consists of a heavy core of twisted coconut fiber over which there is a continuous sennit wrapping. The plumes are closely spaced and have been laid on with their quills against the core, each quill being held in place by two or three turns of the wrapping. Great care was taken to place the plumes so that their natural curve caused those on each half of the band to incline outward and away from the center. Heavy sennit cords, probably a continuation of the fiber in the cores of the bands, spring from either end of the ornament. Other cords of fau bark are attached to the ends of the sennit cords.

The *taavaha* was worn across the forward part of the head, a little back of the forehead, with the plumes rising vertically. The cords at its ends were tied under the chin, like bonnet strings. It was primarily a man's ornament, but was sometimes worn by women dancers at fetes.

Gracia (28, p. 134) says that about 500 feathers were required for a *taavaha*, and that each cock had only two feathers which would serve, so that it was necessary to despoil over 200 cocks to make a single ornament. At the time of his visit a *taavaha* was valued at a gun.

A modified form of the *taavaha* is shown on Plate LXXX, *A*, 1. The bands which form the base of this ornament are like those in the one just described, but the workmanship is not so good. The feathers are much shorter and appear to be cocks' tail coverts. They are made up in small bunches of three to five feathers each, with the quill ends enclosed in short sennit wrappings. The bunches are attached to the cores of the bands by a method resembling that used in attaching the small locks of hair in hair ornaments.

Stewart (59, pp. 247-249) describes still another modification of the *taavaha*. He says:

It [the headdress] consists of a crescent three or four inches broad at its greatest breadth, fixed uprightly in front, the lower edge following the line of the hair on the forehead, and the points terminating at each temple immediately above the ears. A neat border, an eighth of an inch wide, ran around the edges in a herring bone pattern of alternate black and white—while the middle was entirely filled with the small scarlet berries of the *Abrus precatorius*, fastened upon the material of which it was constructed by a gum which exudes from the breadfruit tree. [Compare this description with the gorget (?) shown on Pl. LXXXVIII, *C*, 2.] The crescent formed the front of a cap, fitting closely to the head behind, and the foundation in which the heavy plumage surmounting it is fixed. This plumage consisted of the long black and burnished tail feathers of the cock—the finest I ever saw; those in the center being more than two feet in length. They were arranged behind the front piece as closely as possible, and in such a manner, as to form the shape of a deeply pointed chapeau, placed crosswise on the head—the feathers in the center standing perpendicular, and becoming more and more vertical, till the lowest at the edges drooped deeply over the shoulders. The ends—falling, from the highest point above the forehead, one over another in a regularly defined curve on either side—played in the air with the gracefulness of an ostrich plume, and imparted to the whole an appearance of richness and taste we had not been led to expect from any of the decorations of the country previously seen.

According to Handy a headdress made from the white feathers of the *vak*i bird was also called *taavaha*.

Gracia (28, p. 134) says: "Oftentimes a bunch of other more curious feathers of sea birds, in the form of a plume, are worn at the top or back of the

head in addition to the large *taavaha*." This probably refers to ornaments of the same general type as that shown on Plate LXXX, A, 3, which were made of unusually long tail feathers of the tropic bird attached to a smooth stick by wrappings of fine sennit. The principle of attachment appears to be much the same as that used in the large *taavaha* except that the plumes entirely surround the stick instead of running only along one side of the band. The lower end of the carefully smoothed stick projects for some distance, suggesting that the ornament was thrust into a coil of hair.

Perhaps the most beautiful of the Marquesan headdresses was the *packua*, shown on Plate LXXX, B. Only two of these ornaments were seen, but these agree so closely in all details of construction and decoration as to suggest that the type was a fixed one. It is rather interesting that one of the specimens contains a few peacock feathers, proving it to be post-European.

The body of the *packua* is made up of three strips of featherwork. Each strip is broadest in the middle and tapers to a point at either end. A piece of large bamboo, flattened and scraped to paper thinness serves as a base for the featherwork. Over this are laid one or more layers of fine white tapa, which fit the bamboo so closely as to suggest that they were put on while the tapa was wet. The feathers, all of which are small, are glued to this tapa with breadfruit gum. To give additional security the whole strip is wrapped with single strands of some stiff white fiber—probably banana fiber. In a perfect specimen these wrappings are concealed by the feathers, but in the one figured the wrappings, tapa pad, and bamboo base are all visible. The feathers are laid on in irregular overlapping rows, the work progressing from both ends and meeting in the middle.

The tapa pad varies in thickness in the different strips composing the ornament, being heaviest in the top and bottom strips, less heavy on the ends of the central strip, and thinnest at the center of the central strip.

The three strips are pasted side by side upon a single large piece of coconut leaf sheath, whose natural stiffness serves to hold the ornament in shape. Along either edge, outside the strips, run three flat bands, or ribbons, plaited from strands of black dyed fau bark and white tapa. At either end of the ornament, between these bands, is a small triangular piece of white tapa which serves to cover the tips of the strips of feather work. Long tying strips, braided from tapa and black fau bark, are attached to either end of the ornament. In the specimen figured two tapa strings are fastened to the inside near the top center, suggesting that there was originally an additional ornament which projected above the *packua*.

Green, yellow and red feathers were used. The first two colors were obtained from a species of dove, the *kuku*. The source of the red feathers is doubtful. The usual native story is that they were obtained from the *manu kua*, a red bird long extinct, which lived on the plateaus of Nuku Hiva and Hiva Oa. In an account obtained in Pua Ma'u, Hiva Oa, they are said to have been brought from a far off island called Aotona, which Handy identifies as Rarotonga. A species of *kuku* which has a red cap of the same shade as the feathers in the *packua* occurs in Hiva Oa, and it seems probable that at least some of the feathers used were obtained from these birds. (It should be noted that Dordillon defines *packua* as "head ornament of *kuku* feathers.")

The red, green and yellow feathers on each strip were arranged in vertical bands, the center of the middle strip being covered by a large block of red feathers. Two small designs in red, one of which appears in the illustration, were placed on either side of the centers of the outer strips.

The *packua* is said to have been the ancient headdress of Nuku Hiva and also of the valley of Pua Ma'u in Hiva Oa. It is not mentioned by any of the early writers, however, and

probably was always a rare and greatly valued ornament. A narrow band of featherwork, corresponding to one of the three strips in the large *packua*, was worn as a headdress in Nuku Hiva. It was also called *packua*.

According to Handy the *packua* was worn by young chiefesses at fetes, and was also sometimes worn as a breast ornament. Its principal use, however, was as a man's headdress.

A few other types of feather headdresses seem to have been in use. Forster (25, pp. 15-16) says that some of the natives of Hiva Oa wore "round coronets of the small linguated feathers of the man-of-war bird." Stewart (59, p. 313) says that a *taua* (priest) seen by him in Nuku Hiva wore "a full wreath of red and white feathers, much soiled, in alternate bunches over the forehead and temples." From his notes and from Dordillon's dictionary Handy has compiled names of additional feather ornaments as follows:

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| Heikua: A wreath of red cock feathers worn by women to dance the <i>hakapahaka</i> . The feathers were attached to sennit. | Kohepea: Long cocks' plumes attached to the end of a stick, worn as an ornament. |
| T'ua: An ornament of twelve upright <i>toake</i> feathers, which was worn on the forehead. | Koketata: Aigrette of cocks' plumes on the end of a stick. |
| Hei mekameka: Head ornament of long cocks' plumes. | Pea: Long tail feathers of a cock. Aigrette of these feathers. |
| | Peue: Head ornament of feathers in the form of a visor. |
| | Tua: Aigrette of red feathers of the tropic bird. |

A number of striking headdresses of materials other than feathers were also used by the Marquesans.

Wreaths or garlands of porpoise teeth (*peue ei*), worn principally by women, are still obtainable, although their manufacture has been discontinued for a number of years. The base of these ornaments is a band plaited from a number of strands of twisted coconut fiber. (See Pl. LXXXII, *A*.) The technique is identical with that employed for the bands of hair ornaments. The band is widest in the middle and tapers toward the ends, which are turned over and plaited back into the band on the outer side, forming stiff loops. Through these loops the tying strings, usually of white tapa, are passed.

The teeth were drilled through the root, and were attached as follows: A small bundle of fibers was released from every other cord on one half of the plait, threaded with beads and teeth, and its free end twisted into the corresponding cord on the opposite half of the plait. In almost all specimens both teeth and beads are used, each of the loops having six or more beads at each end and from 10 to 15 teeth in the middle. According to one informant, in ancient times small fish vertebrae were used instead of beads. In one specimen the beads are absent, the entire loop being threaded with teeth. It is evident that the twisting of the cords in the plait, the stringing of the loops, and the plaiting were carried on simultaneously.

In all the specimens examined, the teeth had apparently been drilled with metal tools. The perforations are remarkably small, and the teeth fit the cords on which they are strung so tightly that it is difficult to remove them even when the cords have been broken. Most, if not all, of the teeth used in these wreaths were obtained from the island of Ua Pou. An ordinary wreath contains from 1000 to 1500 teeth, and the demand evidently exceeded the supply, for several wreaths were seen which contained imitation teeth made of bone. A unique specimen, made entirely of bone, is shown on Plate LXXXII, *B*.

When not in use the wreath was straightened and a smooth rod, about half an inch in diameter was run through all the loops, between the teeth and the plaited band. The orna-

ment was thus held rigid, reducing the danger of breakage. It was then rolled in several thicknesses of tapa. When the teeth in a wreath had become yellow or dirty they were scoured with fine sand.

A curious type of headdress (*packaha*) is shown on Plate LXXXI, A. Its manufacture appears to have been limited to Hiva Oa, Tau Ata and Fatu Hiva. It apparently was not made in Ua Pou (Handy) nor in Nuku Hiva, although ornaments of this sort, obtained in trade, were sometimes worn in Nuku Hiva during the early historic period. Some informants of Hiva Oa say that it was not worn in Hiva Oa in ancient times, and ascribe it to Fatu Hiva.

The *packaha* consists of a number of plaques of shell and tortoise shell which are attached to a band of woven coconut fiber. The warp strands run longitudinally, the weft strands passing back and forth across the band in a wrap weave. The direction of the wrapping is changed at regular intervals, producing an ornamental banded effect. The edges of the band are re-inforced by cords somewhat heavier than the regular warp strands, and its ends are finished in stiff loops. The form and weaving of the band is shown on Plate LXXXI, C. The outer surface of the band was originally covered with small discs of mother of pearl about the size of shirt buttons. A small toothed disc of tortoise shell was fastened to the center of each pearl disc. Machine made buttons of china and shell were introduced by the traders at an early time, and soon supplanted the old pearl discs on these headdresses. The ends of the band were covered by pearl shell plates, overlaid with thin openwork strips of tortoise shell. The form and ordinary design of these plates can be seen on Plate LXXXI, A. The end plates were called *kana*, the small discs, *kana momo* (Handy).

The plaques, which form the principle part of the ornament, were fastened to the lower edge of the band. There seems to have been no fixed rule as to the number of plaques, but more than seven tortoise shell and eight shell plaques were rarely employed. They were attached to the band by coconut fibers passed through small holes drilled at their tops, and were fastened together near the lower ends in the same way. The shell plaques were made from large conch or Triton shells, and were highly polished on all surfaces. They were made from the lower end of the shell and preserved its natural curve. The tortoise shell plaques were two or three times as wide as the shell plaques, and were elaborately carved. The decoration usually consisted of a large highly conventionalized human figure in the center, with panels of superposed smaller figures or designs on either side. A narrow band of designs ran across the lower end. The spaces on each side of the head of the large central figure were pierced. In a few specimens the central figure was replaced by two smaller figures, but the examples shown on Plate LXXXI, A, B may be taken as typical. The most curious feature of this decoration is that, when the ornament was on the head, the figures were all upside down. This lends some support to the statement of one informant that the *packaha* was originally worn with the plaques above instead of below the band, although all natives agree that in historic times it was worn with the plaques inverted.

The tortoise shell plaques were bent outward at the bottom, their curve conforming roughly to that of the shell plaques. When the ornament was on the head the lower edge flared outward over the eyes, like the visor of a cap. Many of the tortoise shell plaques are perforated at the lower edge, suggesting that small ornaments were suspended from them. An ornament of white beard (*parahina*) was usually attached to the center of the *packea* band and projected above it.

The materials used in the *packaha* were all obtained locally. Two varieties of tortoise shell bearing turtles were distinguished by the natives, the shell of one species being thick and easily worked, and that of the other thin and brittle. No method of cementing the plates together seems to have been known, and the way in which the tortoise shell plaques were bent has been forgotten. Tortoise shell was highly valued by the natives, and the white traders met the demand by importing brown sheet celluloid. Many of the *packaha* in American col-

lections are of celluloid and the carving on such objects is often superior to that on those of genuine tortoise shell. There are indications that the traders went even further in the *paekaha* trade, for the plaques in a specimen seen in Pua Ma'u, Hiva Oa, seem to have been stamped in a mold. The material used was apparently vulcanized rubber.

Paekaha were made by special *tuhuna*, and according to Handy were paid for in pigs. Land was not legal tender in this case, because the *paekaha* was worn on the head, and if a woman walked on the land given in payment it would be as though she stepped over the head of the owner of the *paekaha*, a great defilement. The holes in the plaques were made with a pump drill and the carvings executed, in ancient times, with rats' teeth.

Paekaha were worn by both men and women and in view of the large number preserved in collections it is rather curious that neither Cook nor Fleurieu mention them in their accounts of the southern islands although they speak of other headdresses for whose existence we have little other evidence. This would seem to strengthen the evidence for their Fatu Hivan origin, and it seems probable that they became popular in the other islands of the group only in historic times.

In contrast to this silence in regard to the *paekaha* we have an abundance of early references to another sort of shell and tortoise shell headdress, the *uhikana* (Handy). Cook says (14, p. 309-310):

Their principle headdress, and what appears to be their chief ornament, is a sort of broad fillet, curiously made of the fibers of the husks of coconuts. In the front is fixed a mother of pearl shell wrought round to the size of a tea saucer. Before that another, smaller, of very fine tortoise shell, and perforated in curious figures. Also before and in the center of that, is another round piece of mother of pearl, about the size of half a crown, and before this another piece of perforated tortoise shell the size of a shilling. Beside this decoration in front, some have it also on each side, but in smaller pieces; and all have fixed to them the tail feathers of cocks or tropic birds, which, when the fillet is tied on, stand upright; so that the whole together makes a very sightly ornament.

Plate LXXXI, C shows the back of one of these ornaments and the inside of the head band. The bands were plaited in the same way as those of the *paekaha*. The pearl shell, of the largest size available, was ground to a regular outline and drilled near the center with two or more holes for attachment.

A very fine specimen, now in the Peabody Museum of Salem, is shown on Plate LXXXII, C. The final disc of tortoise shell is missing—possibly it was never there. The design on the large tortoise shell disc is of the same general type as that illustrated by Cook (14, p. 310). There are indications that two distinct conventions were employed in the carving of these discs.

One convention was characterized by a round disc with elaborate tracery, and an absence of human figures. In the other the disc was oval and from the top center rose two large hooks, with their tips pointing outward. Radiating from the center of the oval were six rather large tiki heads, with the spaces between cut away. Bordering the oval, and joining the tops of the heads, was a continuous band, toothed on the outer edge and delicately pierced and traced. *Uhikana*, in which the oval discs were used, seem usually to have had the ends of the bands covered with plates of mother of pearl and tortoise shell like those used on *paekaha*. Those with round discs lacked the plates. It seems probable that these conventions represent local

variations, but we have no data as to the locality from which the examples in American museums were collected.

The construction of the feather ornaments attached to the *uhikana* is clearly shown in Plate LXXXI, C.

The base of the ornament is a straight stick 8 to 10 inches long, and about $\frac{1}{2}$ an inch thick at the bottom and tapering to $\frac{1}{4}$ inch at the top. This is flattened on the sides. The feathers are laid on with their quills resting against the flat sides, and are held in place by a continuous wrapping of sennit, the work progressing from the top downward. The technique is thus essentially the same as that used in the *taavaha*. The lower ends of the ornaments are inserted between the shell and the band, and attached to the band by loops of sennit.

The *uhikana* was essentially a man's headdress, but does not seem to have been tapu to women. It was worn principally by warriors and dancers, and seems to have been used in all the islands of the group.

A sennit and pearl shell ornament of different type is preserved in the Peabody Museum of Harvard University. The nacre is in the form of small pear-shaped ovals, which are fastened point down upon a sennit band. The band appears to be plaited, and is certainly not woven as are the bands of *packaha* and *uhikana*.

A peculiar object, probably a headdress, is shown on Plate LXXXII, D. It is made from small cords of twisted coconut fiber, and consists of a woven band from which hangs three rows of broad flat fringe.

Edge-Partington (20, p. 47) illustrates a head ornament consisting of a sennit band which bears, in the center of the front, a grotesque head, also woven of sennit, with nacre eyes and pointed teeth.

A few other headdresses are mentioned by early writers. Forster (25, pp. 15-16) says:

"Some wore . . . a circle from which several ranges of twisted strings of coconut coir about two inches long, either of the natural color or dyed black diverged round the head." Krusenstern (34, pp. 156-159) mentions a headdress made of "a ring of soft wood, from which a row of strings is suspended." An informant in Hiva Oa said that a string head-dress called *paeha'a* was used in ancient times, but could give no details of its form. It seems probable that it belonged to one of the types already mentioned.

Fleurieu (23, p. 113) says: "They wear a sort of helmet visor covered with white fabric on which different figures are painted in black."

Aigrettes made from old men's beards were frequently worn with the *peue ei* and *packaha*, and probably with other ornaments as well. They were called *parvahina*. They seem to have been used in all the islands of the group, and are represented in most museum collections. The beards were usually those of old male relatives, but an old man who was not a relative might be paid to let his beard grow for the purpose. The owner of such an ornament can usually give

the name of the man whose beard was used, even when the *pavahina* is several generations old. In spite of the surprising whiteness of the hair in some of these ornaments no method of artificial bleaching seems to have been employed. In almost every specimen there are a few black hairs sprinkled among the white, and rarely tresses of entirely black hair are included.

As may be seen from the illustration (Pl. LXXXII, E.) the *pavahina* was made up from a great number of locks of hair.

To make one of these locks a long tress of hair was doubled over to form a loop through which a very fine cord of twisted coconut fiber was passed. The loop was then wrapped with a single strand of fiber. The two ends of the cord passing through the loop were twisted together to form a single heavier cord. The tresses, with their attached cords, were then gathered into bundles of from ten to thirty, the ends of the cords in each bundle being fastened together and wrapped with sennit in the same way that the individual tresses were wrapped. A sennit cord, heavier than the cords running to the tresses, was attached to the lower end of the bundle. To complete the ornament, from four to ten of these bundles were placed side by side in two parallel rows, and sewn together with single strands of fiber. The cords depending from the bundles were plaited together to form a flat pad, one-half to three-quarters of an inch long, through the lower edge of which passed a long cord which served for the attachment of the ornament. The method of attaching the *pavahina* to the *peue ei*, and its appearance when in position, are shown on Plate LXXXII, A.

Black dyed sennit, or even cords of human hair, were sometimes used instead of ordinary sennit for wrapping the bundles. A crudely made *pavahina*, in which the technique differs somewhat from that described, is shown on Plate LXXXII, F.

The pad and bundle wrappings of the *pavahina* were sometimes whitened with lime or clay, and the ornaments are said to have been laid out in the dew for a few nights before a fete to clean and whiten them.

Pavahina appear to have sometimes been worn on the body or limbs with or in place of the hair ornaments described on p. 424. A photograph of an old Nuku Hiva man in full dress shows a half circle of them worn around the chin as a false beard.

Dordillon gives two terms of considerable interest—*pae mamane*, which he translates "helmet," and *pae veinchae*, which he translates "mask." The existence of these terms appears to be the only evidence for the occurrence of either helmets or masks in the Marquesas.

Dordillon also gives three words for comb; *kofeu*, *pahcu* and *paehu*. No Marquesan combs are preserved in American collections, and there are no indications that combs ever formed part of the Marquesan headdress. If they were used in prehistoric times they were probably toilet articles, not ornaments.

Carved bone tubes were sometimes attached to locks of hair as ornaments. These were identical with those used on the fiber handles of containers and on the cords of large drums.

The tubes were of two types, the simpler of which is shown on Plate LXXXIII, *A*. These simple tubes were made from sections of the smaller human long bones—that is, the radius, ulna and fibula. The spongy interior of the bone was cut out, and the hard surface was decorated with a series of transverse grooves. The tubes range in diameter from $\frac{3}{8}$ to $\frac{5}{8}$ of an inch, and in length from $\frac{5}{8}$ to $1\frac{1}{8}$ inches. Tiki figures of human bone, used either as hair ornaments or handle decorations are shown on Plate LXXXIII, *B*. All the specimens examined were made from sections of the shaft of the humerus or femur. In those of the femur the anterior surface of the bone served as the back of the figure, the linea aspera being used as a center line in carving the features. As a result of this, most of the specimens are asymmetrical. Only heads and bodies are represented, and the heads are disproportionately large. The features are conventionalized in the usual Marquesan fashion. The arms are abbreviated, and the hands are shown either on each side of the body, or with the right hand to the mouth—poses common in other Marquesan carvings. The example shown at the extreme right of the plate is unique in having the right hand resting on the right shoulder. These tiki figures are considerably larger than the simple bone tubes, with a length of $1\frac{1}{2}$ to 2 inches and a diameter of 1 to $1\frac{1}{4}$ inches.

CEREMONIAL OBJECTS

There are a number of Marquesan objects which probably had a religious or ceremonial significance. The most interesting of these is a tapa covered object hewn from a single piece of breadfruit wood (Pl. LXXXIV, *A*) which is listed in the Bishop Museum catalog as an idol.

The lower part or body is in the form of a thin flat tablet. The upper part, or head, juts out sharply from the body in front and protrudes slightly beyond it in the rear. The two sides of the face are slightly concave, meeting in a sharp longitudinal keel. The interior of the head has been roughly hollowed out from the rear, probably to reduce the weight of the object. Two short double pointed sticks of fau wood, only one of which is now in position, were fastened to the back of the head transversely. They were attached with sennit cords which passed through holes in the edges of the object. The body, and the front, top and sides of the head, are covered with ute tapa, which was evidently put on while moist. The back of the head does not seem to have been covered. The tapa is gathered in a knot on the top of the head, and is glued together on the back of the body so skillfully that the joining is hard to detect. The whole object, exclusive of the back of the head, is covered with designs painted in red and black. It is evident that the designs upon the front of the head are intended to represent two large eyes, while bands along the lower edge of the head and on the upper part of the body represent the upper and lower jaws of an open mouth. The spaces around the eyes and inside the mouth, and the front and back of the body, are filled with decorative designs most of which seem to be tattoo designs. The painting was evidently done free hand, and shows considerable skill.

The rough finish of the back of the head in this figure suggests that it was formerly attached to some object in such a way that this part was concealed, but the body of the figure is painted on both sides. Although we have no information as to the use of such figures, it seems possible that they were attached to the beams of houses in *me'ae*, the back of the head resting against the beam and the body hanging below it. Tapa covered bird effigies, painted red, were placed on the ridge pole of the tall pyramidal sacred house at Pua Ma'u, Hiva Oa.

The use of effigies covered with painted tapa in the Marquesas brings to mind the similar Easter Island practice. The figures from the two localities have little more than the principle in common, but in view of the complete absence of such figures elsewhere in Polynesia even this is significant. They are not recorded from Micronesia, and even in Melanesia we find no close parallels, except in New Britain where the Baining are said to make huge tapa covered figures thirty feet high (Lewis).

Small wooden figures were probably made by the Marquesans in ancient times, although the few examples known seem to be post-European. There is no definite information as to their use, but they may have been employed for the same purpose as the small stone figures. (See p. 345.) Plate LXXXIV, *B*, shows a modern wooden figure which is interesting chiefly as an example of the breaking down of the old artistic convention under European influence. The proportions of the body and legs, and the modeling of the legs, are much more naturalistic than in the old stone figures. The arms, on the other hand, are smaller in proportion to the figure than those of the old statuettes. The head is more nearly in

proportion to the body and although the old convention is retained for the features, the eyes are smaller and more elongated. It is interesting to note that many of the modern stone figures, which are purely commercial, show the same changes in convention. Those which do not exhibit this modified convention are crudely naturalistic, and no wooden specimen was seen in which the ancient convention has been accurately reproduced.

A curious double statuette, now in the possession of Mme. Mallius of Ta'aoa, Hiva Oa, is shown on Plate LXXXIV, C. It is made of *toa* wood, and has been stained black, apparently by the process used in coloring war clubs. This would indicate a considerable age, although the carving appears to have been done with metal tools. The lengthened leg and disproportionately shortened arm of the degenerate convention are present, but the faces are surprisingly naturalistic. The two figures, which are male and female, were originally joined together at the back, as in practically all Marquesan double figures.

STRING RECORDS

The use of string records seems to have been more highly developed in the Marquesas than in any other part of Polynesia. Such records served principally to aid the memory in the recitations of chants and genealogies, but Stewart (59, p. 335) mentions a time record consisting of a string of tapa in which a knot was tied at the return of every full moon. One complete string record, and part of a second were collected by the Bayard Dominick Expedition.

The complete record, shown on Plate LXXXIV, *E*, obtained in Pua Ma'u, Hiva Oa, has a cylindrical body and is made from rather small three-strand sennit applied in a wrap weave. The warp strands, which run longitudinally, are placed on a slant so that each strand encircles the cylinder once between the upper and lower ends. The upper end tapers to a point and terminates in a loop. At the juncture of this tapering portion with the body of the cylinder there are five small loops of sennit, placed at equal intervals on the circumference, to each of which is attached a small piece of white tapa. The lower end of the cylinder is open, and its edges are finished with sixteen loops of sennit about one inch in length. To two of these loops are attached long sennit cords which were rolled up, when the object was purchased, and thrust into the interior of the cylinder. The cylinder is six inches long and approximately one and three-quarter inches in diameter. After weaving, it seems to have been blackened with earth. This record was used as an aid in singing the *va'ana* (Handy).

Plate LXXXIV, *D*, shows a geneological record. It is considerably larger than *B*, the string record just described, and is stuffed with some soft material.

From the sides spring six long pointed flaps, three above and three below. The knotted cords, which served to keep the record, seem to be attached to the body without regular order and vary considerably in length. The knots are all double, one half of the knot standing for the husband, the other for the wife. The long cords sometimes divide at some distance from the body, and the branches represent other lines of descent.

The string records, according to Von den Steinen (56), were purely mnemonic and could only be interpreted by the maker, or by one whom he had instructed. They were used to record genealogies, and also as an aid in chants of a religious nature. Records of both sorts were sometimes attached to a single body. If the record was in the possession of a family, the father made a knot at the birth of each child, and untied the knot if the child died. When a son married, an additional knot was added for his wife. The woven body of a geneological record was called *too*, signifying the tap root of a tree, and symbolized the history of the gods and the legendary period of the world. The flaps attached to the body are said to symbolize the brothers of the god Atea.

Deaths may also have been recorded by knot records. Von den Steinen says (56, p. 113):

"I was told that in ancient times, a post, hung with many string records, stood on the western cape of the island of Hiva Oa. There the souls of the dead sprang from a high rock into the sea to begin, submerged, their journey to the ancient home, Havaiki. A priest was delegated to register each death which came to his knowledge with a knot."

A number of interesting records for songs and stories are also figured and described by Von den Steinen. One record (56, p. 111-113) has a body in the form of a woven sack, as large as a child's head. The knotted record was attached to the edge of the sack, and when not in use was kept coiled up within it. The sack was kept hung up by a handle in the house of the *tuhuna*, and was supposed to contain a great number of spells and stories, all of which could be related by the aid of the single cord. Another record is very elaborate. It has a short body, covered with white tapa and decorated with plaited coconut leaves and bunches of midribs of coconut leaflets. To this are attached seven cords for songs and twelve for *mata*. All of these were recited in regular order. Still other small records, of the general type shown on Plate LXXXIV, *E*, were used to instruct chiefs' children in chants. One record (56, fig. 5) is woven from fau bark, an unusual material for these objects.

Von den Steinen (56, p. 113) reproduces a drawing by Porter, entitled "God of the Taipis." It is in the form of a human figure, woven from sennit, and from the loops surrounding the top of the head is identifiable as a string record. Von den Steinen says that the use of these records in the Marquesas seems to have been limited to the islands of Tau Ata and Hiva Oa. An incomplete specimen was, however, collected in Fatu Hiva, and the object from Nuku Hiva figured by Porter seems to prove their existence in the northern part of the group.

String records were used to keep record of taxes in Hawaii, of songs in the Cook group, and of genealogies in New Zealand.

LOCAL DIFFERENCES IN MATERIAL CULTURE

Although the material culture of the Marquesas seems to have been nearly uniform, a few local differences are known to have existed. Most of these differences seem to have consisted in a greater or less stressing of features common to the whole culture rather than in a clear-cut absence or presence of traits. In view of the trade and intercourse which are known to have existed in the group even in prehistoric times the survival of such differences seems to indicate that at some former time the local distinctions were still more pronounced. It is difficult at the present time to establish the extent of the local variation. The culture as a whole has broken down under European contact, and since the intertribal wars have ceased there has been a considerable movement of the native population. Ua Huka, in particular, is at present inhabited chiefly by persons born in other parts of the group.

For convenience of reference the local differences in materials and practice may be summarized as follows:

HOUSES			
	NUKU HIVA	HIVA OA	FATU HIVA
House Platforms	Large and well built.	Small and less well built.	Small and low
	Wide, some square.	Long and narrow.	Long and narrow
	Much cut stone.	Cut stone rare.	No cut stone
	Ornamental masonry.	No ornamental masonry.	No ornamental masonry
Pit for tapu objects.	Common	Absent	Absent
Ridge Pole	Round	Round or many sided.	(?)
Front Stringer	Round or square.	Square or L shaped.	Square or L shaped
Pitch of rear roof.	Very steep	Less steep	(?)
Ornamental lashings.	Extensively used.	On roof only.	(?)
Carved house posts.	Rare or absent.	Normal	Common
Ornamental stone			
images	Not used	Uncommon	Not used
Stone back rests.	Rare or absent.	Common	
Unique features of			
houses	Bamboo partitions.	One grass house.	
Opu type of popoi			
pounder	Not used.	Common	Rare
Salt pounder	Rare	Not used.	Not used
Shape of popoi trough.	Short and broad.	Long and narrow.	Long and narrow

DRESS AND ORNAMENT			
	NUKU HIVA	HIVA OA	FATU HIVA
Tapa	Combined ute and breadfruit used (rare).	Combined ute and breadfruit not used.	(?)
Tattooing	Designs predominantly angular, small natural-istic figures.	Designs predominantly curvilinear, no natural-istic figures.	Same as Hiva Oa
Tattooing Implements.	Comb sometimes fixed permanently in handle.	Comb not fixed in handle	Comb not fixed in handle
Taavaha	Common	Less common	(?)
Incrusted head ornament	Present	Not recorded	Not recorded
Paekaha.	Not made	Common	Common

	NUKU HIVA	HIVA OA	FATU HIVA
String records	Rare or absent.....	Common	Common
Wood carving	Inferior	Good	Good

Stone construction, ceremonial structures, sculpture and methods used for the disposal of the dead are reserved for detailed discussion in a report on Marquesan archaeology in preparation.

STONE CONSTRUCTION			
	HIVA OA	NUKU HIVA	FATU HIVA
Rough Stone.....	Smaller stone, poorer construction	Large stone, good construction	Small stone, poor construction
Cut Stone	Rare except in ceremonial structures	Common in structures of all sorts.....	Rare even in ceremonial structures

CEREMONIAL STRUCTURES			
	NUKU HIVA	HIVA OA	FATU HIVA
Tohua	Large, surrounded by platforms	Smaller, platforms on one side only	Small, enclosed by wall, platform on one side only
Me'ae	Platforms like house platforms, small and simple	Many terraces and platforms, large and complex	Smaller than Hiva Oa but complex
Linking of Tohua and Me'ae	Absent	Constant	Constant

SCULPTURE			
	NUKU HIVA	HIVA OA	FATU HIVA
Wooden Images.....	Common	Common	Common
Stone Images.....	Rare	Common	Rare
Relief Carvings.....	Absent	Common	Rare or absent
Architectural Images...	Very rare	Common	Rare or absent
Detached Heads.....	Very rare	Common	Rare or absent

DISPOSAL OF THE DEAD			
	NUKU HIVA	HIVA OA	FATU HIVA
Mummification in dwelling	Common	Rare	Normal
Mummification in separate house.....	Rare	Normal	Rare
Platform for embalming house	Absent	Common on s. side of island, rare on north	Rare
Coffin	Canoe shaped with wood cover	Trough shaped with cover of poles	Trough shaped with cover of poles
Tree burial	Common	Rare	Rare

Except for stone construction, ceremonial structures and sculpture the local differences now ascertainable within the Marquesas are so slight that little can be deduced from them; but they appear to point to a higher development of carving in the southern islands of the group and of stone construction in the northern islands. The blending of these two influences in Hiva Oa produced the high development of stone sculpture on that island.

CONCLUSION

In spite of the large amount of literature dealing with Polynesia, few parts of this vast region have been carefully studied and there is no part for which the information can be considered at all complete. New Zealand is probably the best known locality. Satisfactory, but by no means complete, information is available for Hawaii and Samoa and the present activities of Bishop Museum will contribute additional information regarding Tonga, the Austral Islands and the Marquesas.

Accounts of the culture of single localities are chiefly valuable as a basis for the careful comparative study, which alone can throw light on the relations of the various Polynesian groups and ultimately on the larger questions of Polynesian origin and diffusion. The final solution of Polynesian problems can come only from a correlation of the evidence along all lines. Comparative studies based on a single class of evidence—traditions, religion, material culture or physical type—serve to arrange the data in order and make them available for such correlation. Theories based upon such partial studies can only be tentative but are justifiable on the basis of Bacon's dictum that truth can be brought out of error much more readily than out of chaos.

Recent studies of physical type have proved conclusively that the Polynesians are not a pure race but are made up of at least three racial elements (70). These elements are a dolichocephalic negroid race, a dolichocephalic or mesocephalic race which shows Caucasian affinities, and a brachycephalic race with slight Mongoloid affinities which Sullivan calls Indonesian (79, *b*, p. 18). The frequency and distribution of the two non-negroid races seems to indicate that they entered the region in nearly pure form. All three races are present in most of the Polynesian islands but they vary in the proportion which they bear to the total population of each group. The negroid element is strongest in Easter Island but is important in northern New Zealand and is found throughout southeastern Polynesia. The Caucasian element is strongest in northern New Zealand and the Marquesas. The Indonesian element is strongest in Tonga but is important in Samoa, southern New Zealand, Hawaii and the northern Marquesas.

Polynesian material culture shows an even more complex condition. The climate and products of all the Polynesian islands except New Zealand are so nearly the same that local difference in culture can not be ascribed to environmental causes, but it is hard to determine which of them are due to differences in the culture of the original settlers of each group. Many of the Polynesian groups are separated from their nearest neighbors by hundreds of miles of open sea and must have originally been settled by very small parties of immigrants. The *tuhuna* system, which placed the more important industries in the hands of

a few skilled workmen, was highly developed among the historic Polynesians and when an immigrant group included no *tuhuna* of a given trade, that element of their original culture would tend to be lost or considerably modified. Primitive cultures are not static, and isolated populations come, in time, to have distinctive cultures. The legendary history of Polynesia points to long periods of quiescence and comparative isolation interspersed with periods of great nautical activity. Features which had been developed locally during a period of isolation might be carried to far distant groups during a succeeding period of voyages. The Polynesians were not conservative and it would have been possible for an immigrant group, too small to materially affect the physical type of an inhabited island, to profoundly modify its culture. Even during the periods of quiescence there was probably intermittent contact between the Polynesian islands through the medium of castaways. Some of the involuntary voyages which have occurred in Polynesia during the historic period have covered great distances, and the vagaries of winds and currents have sometimes carried canoes past many intervening islands to landfalls thousands of miles from their starting points. Castaways were usually well received and although they could hardly have brought about any major changes in culture they may very well have introduced single features such as folk tales, superior mechanical appliances, or new forms of ornaments. Western Polynesia was exposed to influences from both Micronesia and Melanesia. There is known to have been considerable contact between Samoa and the Gilbert Islands; and both Samoa and Tonga have been strongly influenced by Fiji.

In the preceding chapters of this publication a number of resemblances have been pointed out between the elements of Marquesan material culture and those of other parts of Polynesia. The distribution of the more important cultural traits in the Marquesas, New Zealand, Hawaii, the Society Islands, Samoa and Tonga is shown in the accompanying tables. Traits which are everywhere present in identical form, and traits which are limited to a single locality, have been omitted. The distribution of a few of the more important traits of non-material culture is also shown.

COMPARATIVE TABLE MATERIAL CULTURE

HOUSES						
	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Platform</i>	Constant, large, rectangular	Absent	Nearly constant, rectangular	Rare in historic times, rectangular	Limited to temples and chiefs' houses, oval	Rare or lacking
<i>Shape</i>	Rectangular	Rectangular or round (South Island)	Rectangular	Oval or rectangular	Oval, nearly round	Oval
<i>Framework</i>	Ridge pole and end posts	Ridge pole and end posts	Ridge pole and end posts or rigid triangle roof support	Indirect ridge pole support or end posts	Three posts together in center and ridge pole; detachable apses	Indirect ridge pole support, end posts not used
<i>Entrance</i>	Side	End	Side or end	Side	Sides of house open	Side
<i>Door</i>	Wooden slide door or mat	Wooden slide door	No door or mat hung in doorway	No door or mat hung in doorway	.....	Mat door
<i>Interior</i>	Permanent division into floor and bed	Permanent division into floor and bed	Division into floor and bed common but not constant	No division in historic houses; present in ancient times	No internal division	No internal division
<i>Decoration</i>	Ornamental lashings, posts carved with designs and into Caryatid figures	Posts carved into Caryatid figures, carved panels, woven panels, painted rafters	Rudimentary ornamental lashings, no carved decoration	Ornamental lashings, no carving	Ornamental lashings, no carving	Ornamental lashings, no carving
<i>Furniture</i>	No stools, permanently fixed log pillows, soft pillows	No stools, soft pillows or solid wooden pillows	Stools (rare) soft pillows	Stools, legged pillows	Legged pillows, no stools	Legged pillows, no stools
<i>Houses on posts</i>	(Pata'a) Store house and dwelling for old men; elaborately decorated	(Pataka) Store house for food and tapu objects; elaborately decorated	Men's house, no decoration	Small storage places for sacred objects	No houses on posts	Occurrence of store houses on posts uncertain
<i>Sacred houses</i>	High roofed	No sacred houses except those for instruction, these like dwellings	Like dwellings, also tapa covered pyramidal structures	Like dwellings	Like dwellings	Like dwellings

COMPARATIVE TABLE MATERIAL CULTURE—Continued

CANOES						
	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
Construction	Five pieces, dugout body, bow and stern pieces, two side planks; plank canoe also used as rare form	Five pieces, dugout body, bow and stern pieces, two side planks; no plank canoes	Five pieces, dugout body, bow and stern pieces, two side planks; plank canoe known	Made of several courses of planks cut to fit together accurately	Made of several courses of planks cut to fit together accurately	Made of several courses of planks cut to fit together accurately
Bow	Long projection, horizontal or slightly curved upward; head carved on outer end	Long horizontal projection; head or figure carved on outer end	No projection, small upturned knob	Long projection, horizontal or curved upward; small figure sometimes carved on outer end	No projection, upper surface decorated with shells and carved knobs; figureheads used in ancient times	No projection or decoration
Stern	High upward curving plank	High upward curving plank	Small upturned knob, no ornament	Whole body of canoe curved upward for some feet	No projection; decorated like bow	No projection or decoration
Scams	Covered with strips inside and out; strips blackened and decorated with white feathers at the lashings	Covered with strips inside and out; strips blackened and decorated with white feathers at the lashings	Not covered with strips	Not covered, outside of canoe rubbed down to give a smooth close joint at seams	Not covered, outside of canoe rubbed down to give a smooth close joint at seams	Not covered, outside of canoe rubbed down to give a smooth close joint at seams
Lashings	Visible both inside and out	Visible both inside and out	Visible inside, almost concealed outside	Invisible outside	Invisible outside	Invisible outside
Decoration	Elaborate carving on bow, stern and side planks	Elaborate carving on bow, stern and side planks, also painting	No decoration	Small figures and other carving on bow and stern	Slight use of carved decoration	No decoration
Double canoe	Two canoes of equal size temporarily connected	Rarely used; two canoes of equal size	Two canoes of equal size	Two canoes of equal size temporarily connected	Canoes of different size permanently connected	Canoes of different size permanently connected
Sail	An inverted triangle with the apex at the foot of the mast	An inverted triangle with the apex at the foot of the mast	An inverted triangle with the apex at the foot of the mast	Modified form of the inverted triangle sail	Inverted triangle sail and lateen sail suspended from the mast head	Lateen sail suspended from the mast head

COMPARATIVE TABLE MATERIAL CULTURE—Continued

STONE ARTIFACTS						
	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Tonged adz</i>	Dominant form	Dominant form	Over 90 per cent of all adzes	Dominant form	Rare	Not used
<i>Cross section</i>	Triangular or rectangular	Rectangular, triangular forms rare	Rectangular	Triangular	Triangular	.....
<i>Finish</i>	Rough, complete grinding rare	Completely ground, rough finish rare	Rough, complete grinding almost unknown	Complete grinding, rough finish rare	Complete grinding unknown, very crude	Complete grinding normal
<i>Tongless adz</i>	Secondary importance	Secondary importance	Very rare	Rare	Normal type	Only type
<i>Axes</i>	Not used	North Island only	Not used	Found archaeologically, historic use doubtful	Not used	Not used
<i>Melanesian forms</i>	Not found	Present, distribution unknown	Not found	Found archaeologically	Not reported	Many adzes of Fijian form or manufacture
<i>Pounders</i>	Flat and phallic tops, flaring base, tops sometimes carved	Tops round or carved into head, no flaring base	Tops flat, or hemispherical, flaring base	Cross grip with projecting ends, flaring base	No stone pounders	No stone pounders
<i>Pestles</i>	Not found	Present	Common	Common	No stone pestles	No stone pestles
<i>Carved sinkers</i>	Rare	Found on north cape, form closely similar to Marquesan one	Not used	Not found	Not used	Not used
<i>Small figures</i>	Fish and human, common	Human, common on North Island	Fish and human, rather rare	Fish and human, rare	Not used	Not used
<i>Large figures</i>	Common	Rare, limited to localities with tufa deposits	Present but rare, crudely made	Not used	Not used	Not used

COMPARATIVE TABLE MATERIAL CULTURE—Continued

CONTAINERS						
	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Boxes</i>	Oval, often bird form, tight cover	Oval, tight cover	Round, tight cover	Present, form unknown	Round, tight cover	No data
<i>Bowls with legs</i>	Not used	Not used	Present but rare	Oval form common	Common	Common
WEAPONS						
	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Clubs</i>	Paddle club and uu, no bludgeon or throwing club	Characteristic local forms	Short bludgeons, stone headed club (rare); throwing club	Bludgeon, modified paddle club, sickle club, no throwing club	Many types, mostly of Fijian origin, throwing club important	Many types, mostly of Fijian origin, throwing club important
<i>Shark tooth weapons</i>	Knives, no true weapons	Knives, no true weapons	Knives, no true weapons	Many-pronged weapon and sickle	Not used	Not used
<i>Bow</i>	Toy and for fishing	Used traditionally as weapon	Toy and for rat hunting	Used in chief's game	Toy and fishing	Important weapon
<i>Sling</i>	Important	Occasionally used as weapon, also toy	Important	Important	Common	Little used
<i>Sling stone</i>	Double conical	Not shaped	Double conical	Not shaped	No data	No data
<i>Throwing cord</i>	In games only	Stick with cord	Not used	Not used	Not used	Not used
<i>Spear with head cut to break off in wound</i>	Present	Several types	Not used	Not used	Not used	Not used
<i>Chief's staff</i>	Important, blade flat, upper end enclosed in woven sleeve, top decorated with hair	Important, blade flat, upper end enclosed in woven sleeve, top carved	Not used	Not used	Not used	Not used
<i>Armor</i>	Not used	Several thicknesses of mats	Thick mats and wicker helmets	Breast plates of heavy fiber, helmets	One-piece suit like Gilbert Islands, very rare	Not used

COMPARATIVE TABLE MATERIAL CULTURE—Continued

	MUSICAL INSTRUMENTS					
	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Shell trumpet</i>	Cassia and triton shells, latter with separate mouth piece	Triton shells with separate mouth piece	Cassia shells, no separate mouth piece	Triton shells, separate mouth piece	Triton shells, no separate mouth piece	Triton shells, no separate mouth piece
<i>Wooden trumpet</i>	Important	Important	Not used	Not used	Not used	Not used
<i>Drum</i>	Vertical cylindrical with skin head	Canoe shaped, also wooden gongs	Vertical cylindrical with skin head	Vertical cylindrical with skin head	Horizontal slotted	Horizontal slotted
<i>Mouth flute</i>	Important, one form tunable	Important, no tunable form	Not used	Not used	Present but rare	Rare or absent
<i>Nose flute</i>	Important	Present	Important	Important	Not used	Present
<i>Musical bow</i>	Present	Not used	Highly developed, with three strings	No data	Not used	Not used
<i>Jew's harp</i>	Present	Not used	Form identical with Marquesan	No data	Not used	Not used
<i>Slotted bamboo</i>	Not used	Not used	Not used	Important	(?)	Not used
<i>Lengths of bamboo beaten on ground</i>	Not used	Not used	Present	Not used	Important	Present
TOYS						
<i>Sticks</i>	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
	Important	Present	Present but rare	Present	Not used	Not used
<i>Surf board</i>	Present	Present	Important	Present	Present	Not used
<i>Dart throwing</i>	Important	Important	Present	Present	Present	Present
<i>Boatling</i>	Not used	Not used	Important	Not used	Not used	Not used
<i>Coasting</i>	Not used	Children only	Important	Not used	Not used	Not used
<i>Kites</i>	Present	Important	Present	Children only	Not used	Not used
<i>Draft game</i>	Not used	Present	Present	Not used	Not used	Not used

COMPARATIVE TABLE MATERIAL CULTURE—Continued

DRESS AND ORNAMENT

	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Tattooing</i>	Men completely tattooed; women on legs, arms and lips	Men tattooed on face and thighs; body tattoo rare; women on lips and chin	Men sometimes completely tattooed except face	Men tattooed on body and limbs but not on face; women on lower leg and arms, also a girdle	Men tattooed waist to knee; women on arms and legs	Like Samoa
<i>Tapa making</i>	Stone, hollow wooden and solid wooden anvils; square and round beaters, grooves but no water marks	Obsolete, no data on manufacture	Hollow wooden anvil, square and round beater, beaters with water marks or grooves	Hollow wooden anvil; square beater with water marks on one or two sides, other sides grooved	Smooth log, not hollowed, square beater, grooved on three sides, no water marks	Like Samoa
<i>Tapa decoration</i>	Dyed yellow	.....	Painted, stamped with bamboo stamps or flowers (rare)	Free hand painting, stamped with flowers or leaves	Free hand painting and painting over carved block	Free hand painting and painting over carved block
<i>Feather work</i>	Feathers pasted on base; no feather cloaks	Feathers caught into woven fabric; feather cloaks important	Feathers caught into netted fabric; feather cloaks important	Feathers caught into netted fabric; no feather cloaks	Woven in edges of fine mats	No data
<i>Necklaces of many strands of braided hair</i>	Important	Not used	Important, part of chief's insignia	Turban of many strands of braided hair, no necklace	Not used	Not used
<i>Fans</i>	Highly decorated, carried by chiefs	No data	Highly decorated fans sometimes used by chiefs	Elaborate but not ceremonial	Elaborate but not ceremonial	Elaborate but not ceremonial
<i>Fly flap</i>	Not used	Not used	Elaborately decorated feather flaps part of chief's insignia	Elaborately carved, ceremonial (?)	Carried by speaker chiefs	Common, ceremonial (?)

ART

	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Carving</i>	High development with application to houses, canoes, tools and utensils	High development with application to houses, canoes, tools and utensils	Poor development, not used on houses, canoes or tools, a few utensils decorated with figures carved in round	Moderate development, applied to canoes and some utensils	Poor development, applied to canoes (crude) and weapons	Poor development, weapons only
<i>Inlay</i>	Not used	Eyes of images only	Eyes of images and a few utensils	Rare or absent	Not used, carved designs on weapons filled with lime	Crude, weapons only
<i>Painting</i>	Practically absent	Applied to rafters, canoes and images	Tapu only	Tapu only	Tapu only	Tapu only
<i>Designs</i>	Curvilinear or angular geometric; spiral predominant; use of conventional faces or figures as decoration; floral and animal forms rare	Curvilinear, angular geometric designs rare; spiral predominant; use of conventional faces or figures as decoration; floral and animal forms rare	Angular geometric designs with a few floral; spiral absent; human or animal forms not used	Angular geometric or circles, no spirals; human and animal figures in tattoo; floral designs on tapu	Angular geometric or floral; spiral rare or lacking; human and animal figures (outline) on weapons	Angular geometric or floral; no spirals; figures rare or lacking
<i>Treatment</i>	Surface divided into zones or sections which are treated separately; occasional superposition of designs	Surface divided into a few large sections or treated as a whole; superposition of designs common	Designs applied in stripes or over whole surface (tapu only); no design superposition	Carved surfaces divided into sections treated separately; tapu surface treated as whole; no design superposition	All surfaces divided into sections treated separately; no design superposition	All surfaces divided into sections treated separately; no design superposition
<i>Human figures</i>	Conventionalized only	Conventionalized and naturalistic	Conventionalized and naturalistic	Conventionalized, very crude	Not used (one doubtful example)	Rare, no data on form

CONVENTIONS OF HUMAN FIGURES

	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Leg</i>	Half flexed	Half flexed	Half flexed	Half flexed	.....	.....
<i>Arms</i>	At sides, hands on abdomen or one hand to mouth	At sides, hands on abdomen or one hand to mouth	At sides, hands on hips. Hand to mouth position not used	At sides, hands on abdomen or one hand to mouth	.....	.....
<i>Hands</i>	Five fingers of equal length, outer fingers connected by groove behind three inner	Three fingers of equal length	Five fingers when indicated	Five fingers or not indicated	.....	.....
<i>Body</i>	Formed by a series of planes meeting at well defined angles	Simple treatment, rounded contours	Formed by a series of planes meeting at well defined angles or simple treatment with rounded contours	Formed by a series of planes meeting at well defined angles (not common) or simple treatment with rounded contours	.....	.....
<i>Mouth</i>	Exaggerated, oval, prominent tongue	Exaggerated, beaked or figure eight form, protruding tongue	Exaggerated, beaked or figure eight form or oval (semi-naturalistic figures); protruding tongue, common in semi-naturalistic figures	Exaggerated, oval, prominent tongue, or naturalistic mouth	.....	.....
<i>Nose</i>	Flat, nostril exaggerated	Nostril exaggerated, bridge of nose not shown in many cases	Nostril exaggerated, bridge of nose not shown in some cases	Higher than Marquesan convention and more naturalistic, nostril exaggerated	.....	.....

COMPARATIVE TABLE MATERIAL CULTURE—Continued

STONE CONSTRUCTION

	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Eye</i>	Broadly oval to round, encircled by raised rim; straight or with slight upward slant	Narrow pointed oval, pronounced upward slant	Narrow pointed oval, pronounced upward slant; also straight eyes (less common)	Pointed oval encircled by raised rim; eye sometimes omitted	.....	.....
<i>Brows</i>	Exaggerated, high, arched	Exaggerated, high, arched	Exaggerated, high, arched	Exaggerated, high, arched or straight	.....	.....
<i>Rough stone</i>	Highly developed, wall terrace and platform	A few extensive structures, little or no stone construction in recent times	Highly developed, wall terrace and platform	Well developed, wall terrace and platform	Moderate development, wall and platforms. Large ancient structures	Moderate or poor development, wall and platform
<i>Cut stone</i>	Highly developed, rectangular slabs set on edge to face terraces or platforms	Not used	Rare, rectangular slabs set on edge to face terraces or platforms	Highly developed, rectangular slabs set on edge to face platforms, conical forms	Fale o le Fe'e only; stone posts	Highly developed, rectangular slabs set on edge to face platforms and trilitheon

MORTUARY PRACTISES

	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Mummification</i>	Normal; evisceration by anus and rubbing with coconut oil; in dwelling or special house	Rare in historic times; evisceration by anus, rubbing with oil and smoking, special house	Not practised, temporary preservation by filling body with salt or by varnishing	Normal, evisceration thru incision and rubbing with coconut oil; in special house, anciently in dwelling	Practised by one family only; method like Society Islands	Not practised
<i>Earth burial</i>	Rare, limited to priests and diseased or insane; flexed position (?)	Rare, usually limited to slaves; flexed position	Lower chiefs, some priests, commoners; chiefs and priests extended, commoners usually flexed	Limited to lowest class, flexed position	Normal, extended position	Normal, extended position
<i>Body kept until disintegration</i>	Normal	Normal	Rare; decay hastened by burial and fire	Normal	One family only (see mummification)	Not practised
<i>Disposal of bones</i>	Placed in cave or sacred place; skulls of chiefs preserved	Placed in cave or hollow tree; heads of chiefs sometimes preserved	Kept in dwelling, in special house or in sacred place or placed in caves	Skulls preserved, bones buried in sacred place or put in cave	Skulls of chiefs sometimes kept	.....
<i>Vaults</i>	Priests only, form of vault unknown	Not used	Vaults in platforms, priests and lower chiefs (?)	Not used	Rare if present	Stone vaults in mounds (langi) used by all chiefs

COMPARATIVE TABLE MATERIAL CULTURE—Continued

MISCELLANEOUS FEATURES

	MARQUESAS	NEW ZEALAND	HAWAII	SOCIETY ISLANDS	SAMOA	TONGA
<i>Cannibalism</i>	Highly developed	Highly developed	Absent	Absent	Present traditionally	Introduced from Fiji
<i>Headhunting</i>	Highly developed, skulls of enemies decorated and preserved	Highly developed, heads preserved	Absent	Heads of enemies taken but not preserved	Heads of enemies taken but not preserved	Enemy heads not preserved
<i>Government</i>	Chiefs of little power, power greater in northern islands; no overlords, loose tribal confederacies	Chiefs, no overlords, loose tribal confederacies	Highly organized, chiefs and overlords; large political units	Highly organized, chiefs and overlords, large political units	Tribal organization, confederacies with high chiefs	Highly organized, whole group a political unit
<i>Personal divinity of chiefs</i>	Suggested in northern islands only	Chiefs god descended	Highly developed	Highly developed	Highly developed, speaker chiefs with real power	Highly developed, divine chief with little secular power
<i>Religion</i>	Ancestor worship, great gods known but ignored	Worship of great gods and a host of minor deities, ancestor worship not important	Worship of great gods and ancestor worship	Worship of great gods, family ancestor worship	Village gods embodied in animals, no true ancestor worship	Worship of dead chiefs; great gods secondary
<i>Priesthood</i>	Organized within tribe, inspirational and ceremonial priests	Priest-chiefs and wizards, no regular organization	Highly organized, ceremonial priests important	Highly organized, ceremonial priests important	Priests and priest-chiefs, no regular organization	No organized priesthood, inspirational priests important
<i>Human sacrifice</i>	Highly developed	Common	Highly developed	Less developed than in Hawaii or the Marquesas	Not used	Not used
<i>Sacred structures</i>	Platforms or terraces with temporary houses, large stone enclosures with both secular and religious functions	No permanent sacred structures; sacred houses for instruction of young men	Stone enclosures tapu to all but chiefs and priests, also platforms	Stone enclosures with pyramid at one end; commoners admitted to enclosure but pyramid tapu to them.	Village house or small house on platform	House on pyramid containing burial vault
<i>Education</i>	Organized instruction for both men and women in special house	Organized instruction for young men in special house	No organized instruction	No organized instruction	No organized instruction	No organized instruction

It can be seen from the tables that Samoa and Tonga show a closer cultural agreement than any other two Polynesian localities. The Marquesas and New Zealand show an almost equally close agreement. The Society Island culture occupies an intermediate position with numerous resemblances to both the Samoan-Tongan and Maori-Marquesan cultures. The Hawaiian culture resembles the Maori and Marquesan on the material side, but its non-material features are more closely related to those of the Society Islands and western Polynesia.

The Maori and Marquesan cultures show so many similarities that, in the absence of historic contact, they must be considered as not very divergent developments of a single ancestral culture. The content of the various New Zealand culture areas outlined by Skinner (78) has not yet been established, but most of the traits common to New Zealand and the Marquesas seem either to have been limited to the north island or to have been much more highly developed there. According to Maori traditions the north islanders were descendents of immigrants who came to New Zealand from Tahiti and the Cook Islands in the twelfth century (Smith, 79, p. 223). The traditions of the southern Marquesans indicate migration from Tahiti and the Cook Islands, and mention groups still farther to the west. It seems practically certain, therefore, that a culture similar to the historic Maori and Marquesan cultures formerly existed in southeastern Polynesia.

The Maori and Marquesan cultures differ from the Samoan and Tongan cultures in so many respects that the two complexes must have been largely derived from different sources. The original cultures of Samoa and Tonga probably differed considerably from the historic ones. Cannibalism and the use of the bow as a weapon in Tonga, and the elaborate club forms of both Tonga and Samoa were due to Fijian influence. The Samoans ascribe the introduction of tapa making to a Fijian chief and their tapa making implements are almost identical with the Fijian ones. The slotted drum was almost certainly borrowed from Fiji. Legged pillows were probably borrowed from Fiji, where the form of the coiffure made them necessary. Legged utensils may also have been borrowed as such utensils are more numerous and of more diverse form in Fiji than in either Samoa or Tonga. Even the use of round or oval houses may not have been a feature of the original Samoan-Tongan cultures for round houses are practically absent in Indonesia and Micronesia but are found in both Fiji and New Caledonia.

The western Polynesian cultures have many features in common with Micronesia. The resemblances seem to be more marked in the Caroline and Marshall groups than in the Gilbert Islands. Micronesia is still too imperfectly

known to permit of detailed comparison, but the Caroline and Marshall cultures have in common with the Samoan-Tongan culture a considerable development of chiefly power with a tendency toward fixed social classes; extended earth burial, often with orientation; the use of many piece canoes and lateen sails; and a high development of mat weaving with the use of mats for clothing. Many other features of the Samoan-Tongan culture are also found in Micronesia but are less universal in their occurrence. Although it is possible that these features were borrowed from Micronesia by the western Polynesians, it seems more probable that the original culture of the Samoans and Tongans was essentially Micronesian in type.

The affiliations of the Hawaiian culture are difficult to establish. The Hawaiian culture resembles the Maori and Marquesan cultures in the form and internal arrangement of houses; canoe structure and sail; use of the stone pounder and tanged adz; stilts and surf board; in the use of human effigies and in the conventions applied to them; also in the rarity of utensils with legs and absence of legged pillows. It shares with the Marquesas the use of stone house platforms; extensive ceremonial structures of stone; a pounder with a flaring base; prepared sling stones; the musical bow; the large vertical drum with a skin head; and necklaces made from many strands of plaited human hair. These features are lacking in New Zealand. The Hawaiian culture also has a few features in common with the Society Islands which are lacking in the Marquesas. The most important of these are an organized priesthood; a centralized government with divine chiefs; and the use of netted featherwork, helmets, flyflaps, painted tapa decoration and watermarked tapa beaters. Many voyages between Hawaii and the Society Islands were made from 1100 to 1300 A.D. (Smith, 79 *a*, p. 223) and according to Hawaiian traditions the use of enclosed religious structures, the vertical drum, human sacrifice, increased centralization in government and a stronger organization of the priesthood were introduced into Hawaii at that time. It is impossible to tell whether the other similarities of the Hawaiian and southeastern Polynesian cultures are due to this relatively late contact, but it seems probable that those features which show a very close agreement—such as netted featherwork, tapa painting, watermarked beaters and the conventions employed for human effigies—were brought to Hawaii by the southern immigrants. The similarities in canoes, houses and stone implements, on the other hand, are probably more ancient and point either to an earlier contact or to the partial derivation of both the Hawaiian and southeastern Polynesian cultures from the same source. The main features which distinguish the Hawaiian culture from the Maori and Marquesan cultures are the high social and religious organization of the Hawaiians and the absence in Hawaii of cannibalism, head

hunting, organized instruction for young men, curvilinear art and decorative carving. Stone construction was also highly developed in Hawaii although practically absent in New Zealand. If those features which were probably introduced into Hawaii from southeastern Polynesia in comparatively recent times are eliminated, the residual Hawaiian culture is intermediate between the Maori-Marquesan and Samoan-Tongan cultures but seems to be most closely related to the Maori-Marquesan cultures.

The Marquesas and Hawaii have several features in common which are lacking in New Zealand. Although the historic culture of all the Marquesan islands was nearly the same, decorative carving and curvilinear art seem to have been more highly developed in the southern islands of the group, while stone construction was more highly developed in the northern islands. The northern islands also showed an increased tendency toward centralized government and toward a belief in the divinity of chiefs. The resemblance of the Marquesan culture to that of Hawaii was thus more marked in the northern than in the southern islands of the group. The southern islands are more desirable for settlement and lie nearer to the Society group so that immigrants from southeastern Polynesia would be likely to encounter them first. The traditions of the southern Marquesans indicate that they did not reach the group until about 1000 A.D. (Handy, personal correspondence). It seems probable, therefore, that the historic culture of the Marquesas was a blend between an original culture somewhat like that of the early Hawaiians and a Maori like culture which entered the group from Southeastern Polynesia at some later time.

The Society Island culture is intermediate in many respects between the Maori-Marquesan and Samoan-Tongan cultures. As it is almost certain that cultures similar to the Maori and Marquesan ones formerly existed in southeastern Polynesia it seems probable that the Society Island culture is a blend between an early culture of Maori-Marquesan type and a culture of western Polynesian type. Society Island culture shows a few distinctive features, the most important of which are an organized priesthood and a considerable centralization of government with suggestions of a feudal system. The historic Samoan-Tongan culture shows a tendency toward centralized government and it seems probable that the distinctive features of the Society Island culture originated in the Society Islands as a result of the contact of immigrants from western Polynesia with a subject population.

It is possible to distinguish three main types of culture in Polynesia. These cultural types correspond in a general way with the culture areas distinguishable in other parts of the world, but their historic distribution was not geographically continuous. One type of culture, linked with populations pre-

dominantly Indonesian, centered in western Polynesia. A second type seems to have centered in southeastern Polynesia, associated with people predominantly Caucasian, but who showed considerable negroid admixture. This type survived into historic times in the Marquesas and New Zealand but had been greatly modified in the Society Islands by immigrants with a culture of western Polynesian type. A third culture, associated with populations of mixed Indonesian and Caucasian type with little negroid admixture, formerly existed in Hawaii and the Marquesas, but had been modified or displaced in the Marquesas by immigrants with a culture of southeastern Polynesian type. Two of the cultural types are, therefore, linked with mixed populations and have either been introduced into Polynesia by mixed groups of immigrants or have been developed from the fusion in Polynesia of races dissimilar in physical type and probably in culture. The evident correlation between culture and physical type in Polynesia points to a relatively recent settlement of the region.

The Samoan and Tongan cultures apparently are not hybrids produced by the complete fusion of originally distinct cultures. They are rather to be considered as developments of a single comparatively simple culture which has been modified by borrowing from several sources. This culture seems to have been characterized by the use of rectangular houses or houses with a rectangular center and apses, many piece canoes and lateen sails; bludgeon clubs and possibly throwing clubs; a high development of mat weaving with a use of fine mats as clothing; an angular geometric art with a poor development of wood carving and a rarity or absence of human effigies; a moderate development of stone construction, extended earth burial for commoners and vault burial for chiefs; a tendency toward centralized government with divine chiefs and social classes; elaborate geneologies, and a worship of gods or dead chiefs. The Samoans and Tongans appear to be racially more homogeneous than the inhabitants of any of the other large Polynesian groups and are predominantly brachycephalic (Dixon, 70 *a*, Pl. XXII-XXV), with a large proportion of the Indonesian race (79 *b*, p. 19). It seems probable, therefore, that the culture just outlined was introduced into Polynesia by immigrants of Indonesian race.

The Maori and Marquesan cultures, which seem to be the historic representatives of the old southeastern Polynesian type of culture, show a number of Melanesian affinities. Maori art resembles that of the Massim region of New Guinea and that of some parts of New Britain, New Ireland and the Solomon Islands much more than it does that of western Polynesia. The five-piece type of canoe construction was used in most of the Melanesian localities where the natives built large craft and the highly decorated bows and sterns of the Maori and Marquesan canoes are suggestive of some Melanesian forms. Cannibalism,

head hunting, preservation of the skulls of ancestors, exposure or preservation of corpses, instruction or initiation of young men, absence of large governmental units and chiefs of little power are all of wide occurrence in Melanesia although lacking in western Polynesia. In spite of the general Melanesian tone of the Maori and Marquesan cultures, analysis shows that they are not closely linked with the culture of any one Melanesian locality. The art resemblances are general rather than specific and the Maori-Marquesan image conventions are practically absent in Melanesia. The non-material traits common to the Maori-Marquesan and Melanesian cultures are of very wide occurrence in Melanesia and are present in cultures which differ considerably on the material side. Single traits of the Maori and Marquesan material cultures are often present in one or two of the Melanesian cultures but the distribution of these traits is so irregular that little can be deduced from it.

Both the culture and physical type of the northern Maori and southern Marquesans indicate that their ancestors had been in contact with some negroid people. It has generally been assumed that this contact occurred in the course of their migration from Indonesia and that the Melanesian elements present in Polynesia reached that region as inclusions in some non-negroid race. Churchill (69, p. 139) advances the theory that the Polynesian immigrants coasted along Melanesia and made many stops to rest and raise crops, in this way coming into close contact with the negroid peoples of the region. The northern Maori and southern Marquesans are predominantly of the Caucasian race and if this race came by way of Melanesia and picked up negroid blood and Melanesian cultural traits in transit, we should expect to find negroid blood and Melanesian traits in all the groups where the Caucasian element is important. It is important in Hawaii, where there is very little of the negroid element (Sullivan, 79, *b*, p. 19) and where the culture shows hardly any Melanesian affinities. It seems probable, therefore, that at least some of the Caucasian immigrants into Polynesia had had little or no contact with Melanesians at the time of their arrival. The population of Easter Island, which lies on the extreme eastern edge of Polynesia, shows a larger proportion of negroid types than that of any other Polynesian locality (Dixon, 70, *a*, p. 370). Stone implements which are of Melanesian type and which differ considerably from those used by the historic population have been found in Tahiti. It seems improbable that a racial element which entered Polynesia as an inclusion would have retained its distinctive implement types or would have been strong enough to dominate physically in the easternmost Polynesian island thousands of miles from Melanesia. It is more probable that the population of central and southeastern Polynesia was at one time predominantly negroid in physical type and Melanesian rather than Polynesian in culture.

The southeastern Polynesian type of culture probably originated in central and southeastern Polynesia through the fusion in that region of an early negroid population with immigrants of the Caucasian race. The cultures of these two races no doubt differed considerably but it is almost impossible to tell which of the features present in the resulting culture are referable to the negroids and which to the Caucasian immigrants. The presence of a feature of the southeastern Polynesian culture in Melanesia is not sufficient evidence for its ascription to the negroid population, for the Caucasian people probably reached Melanesia as well as Polynesia. The contact of two cultures which are not too widely separated in the scale of development is stimulating to both. Ideas and appliances are borrowed back and forth and worked over to conform to the pattern of the borrowing culture. When dissimilar cultures fuse, the resulting complex is comparable to a chemical rather than a mechanical mixture. Some features of the original cultures may survive with little change but others will be greatly modified and new features may arise which can not be directly traced to either of the ancestral cultures. In view of the general situation in Melanesia and Polynesia the following traits may be tentatively ascribed to the culture of the negroid stratum in the Polynesian population:

Round, oval or canoe shaped houses, five piece canoes with decorated bows and sterns, axes and smoothly ground tangless adzes, staves and sickle or pick clubs, the throwing cord, curvilinear art, cannibalism, spirit worship, initiation or instruction for young men.

The culture of the Caucasian immigrants seems to have been characterized by the use of rectangular houses with permanent beds, special houses on posts, five-piece canoes, double canoes, triangular sails, partially ground angular tanged adzes, stone pounds, stilts, kites, human effigies, stone construction, exposure or preservation of corpses with flexed burial for the very poor or diseased, preservation of skulls of ancestors, head hunting and ancestor worship.

The blending of these two cultures produced a hybrid culture which was richer than either of its parents. There was a considerable improvement of technical processes and a remarkable efflorescence of art. Several new features of material culture seem to have been developed. Among these were the use of wooden slide doors in dwellings, a characteristic form of canoe decoration, fully ground angular tanged adzes, small stone effigies, shell trumpets with separate mouth pieces, wooden trumpets, oval boxes with tight fitting covers, rigid conventions in the pose of human effigies, and probably the practise of mummifying corpses by evisceration and long continued rubbing with oil.

The Hawaiian culture resembles the southeastern Polynesian culture in some respects but lacks most of the features which, because of their wide oc-

currence in Melanesia, are probably referable to the negroid stratum in the southeastern Polynesian population. It also has several features in common with the western Polynesian culture. It seems probable, therefore, that it is a blend between a culture of western Polynesian type and the culture of the Caucasian immigrants who mixed with negroids to produce the southeastern Polynesian culture. The historic Hawaiians are predominantly brachycephalic but Sullivan concludes that they are a thorough mixture of the Caucasian and Indonesian races.

Each of the three races present in Polynesia probably entered the region at a different time and brought with it a distinctive culture but it is still impossible to establish their chronological sequence. The negroid race was probably the first to arrive in central and southeastern Polynesia. The main argument which has been advanced against the presence of a negroid population in this region has been the supposed inability of negroid peoples to make the long voyages necessary to colonize Polynesia. It is improbable that a race able to reach Fiji from the New Hebrides, the nearest Melanesian group to the west, would have been unable to cross the shorter stretch of sea separating Fiji from Tonga or to make the only slightly longer trip from Fiji to Samoa. The central and southeastern Polynesian groups are comparatively close lying and it would not have been difficult for even poor navigators to pass along them as far east as the Austral and Tuamotu Islands. It is not necessary to suppose that the migration of the negroid race was a deliberate or organized movement. It is probable that, like the historic Melanesians, they disliked long voyages but their presence in Fiji proves that they had seaworthy vessels and it would always be possible for a canoe to be blown out of its course and carried to islands unknown before. There is no indication that a pure negroid race reached Hawaii and the negroids probably did not reach New Zealand or the Marquesas except as inclusions in some superior race.

The order of arrival in Polynesia of the Caucasian and Indonesian races must be left an open question. The traditional movements in Polynesia have been from west to east and from southeastern Polynesia to Hawaii, the Marquesas and New Zealand. As the Indonesian stock seems to be strongest in western Polynesia this may indicate that it was the last to arrive. At the same time, the Indonesian element in the populations of New Zealand and the Marquesas seems to be strongest in those localities which are least desirable for settlement and which are farthest from the probable points of arrival of immigrants from the rest of Polynesia. In New Zealand and the Marquesas, therefore, the Indonesian race may have preceded the Caucasian race. It seems probable that the sequence of arrival of the three races in central and southeastern Polynesia was first, Negroid; second, Caucasian; third, Indonesian. The priority

of the Indonesian race in the more distant Polynesian localities may have been due to their greater skill as navigators. The use of many piece canoes and lateen sails, which was apparently a feature of the Indonesian culture, gave them a freedom of movement which the negroid and Caucasian races probably lacked. Polynesian traditions mention long voyages of exploration and the sailing canoes of the Tongans carried complements of over a hundred men and were hardly more dependant upon winds and currents than European sailing vessels. It would not be difficult for a race which used such canoes to pass by islands which were held by hostile populations and establish itself in more distant islands which it found unoccupied or sparsely settled. The Indonesian race may have colonized both western and marginal Polynesia before it succeeded in conquering the large mountainous islands of southeastern Polynesia. The establishment of cultures of western Polynesian type in southeastern Polynesia must be quite recent for cultures of Maori-Marquesan type were still in existence there at the time of the twelfth century migration to New Zealand.

The routes by which the negroid, Caucasian and Indonesian races reached Polynesia can not be fully established until we have fuller information on Micronesia and Melanesia. The historic distribution of races and cultures in Polynesia seems to be best explained by the following hypothesis: The first settlers of central and southeastern Polynesia were negroid in race and Melanesian rather than Polynesian in culture. They entered the region largely as a result of accidental drifts and settled in Tonga, Samoa, and the Cook, Society, Austral and Tuamotu groups, but did not reach any of the more distant Polynesian localities. They came originally from Melanesia, probably from Fiji. The next immigrants to reach Polynesia were of the Caucasian race and had come from Indonesia by way of Micronesia. They arrived first in Samoa and spread over the territory held by the negroid people, mixing with them to produce a hybrid race and the southeastern Polynesian type of culture. A fairly pure group of the Caucasian race reached and colonized the Marquesas, which they found unoccupied or only partially settled by the negroids. A mixed group, in which the negroid element predominated, reached Easter Island. The Caucasian immigrants did not, at this time, reach either Hawaii or New Zealand. While the main body of the Caucasian immigrants were passing through Micronesia another group of the same race were coasting southward through Melanesia. This wing of the Caucasian migration was probably absorbed or dissipated before it reached Polynesia but it modified the culture of the eastern Melanesian islands to a considerable degree. The last immigrants to enter Polynesia in large numbers were of the Indonesian race. They came from Indonesia, like the Caucasian immigrants, and passed by way of Micronesia. In Micronesia their

vanguard met and mixed with the rearguard of the Caucasian immigrants and a group of this mixed people sailed eastward, perhaps from the Marshall group, and discovered and colonized Hawaii. The main body of the Indonesian invaders arrived first in western Polynesia and established themselves most thoroughly in Tonga, where the islands were comparatively small and level. In Samoa, where the islands were large and mountainous, the earlier Caucasian and negroid population held out for a considerable time and was able to somewhat modify the culture and physical type of the conquerors. In Niue, an isolated group of the earlier population survived into historic times. The Indonesians sailed southward from western Polynesia and discovered and colonized New Zealand. They also spread over southeastern Polynesia and reached the Marquesas. In that group they mixed with the earlier Caucasian population producing a culture somewhat like that which had been carried to Hawaii by immigrants of mixed Caucasian and Indonesian race. They were unable to displace the mixed Caucasian and negroid populations of the larger southeastern Polynesian islands but they established colonies on these islands. This first Indonesian invasion was followed by a period of comparative quiescence during which few voyages were made. About the year 1000 A.D. (79, *a*, p. 223) a second period of voyages commenced. It is impossible to tell what caused the resumption of nautical activity, but it seems probable that western Polynesia had become overpopulated and that the culture of the Indonesians in that region had been stimulated by their contact with Fiji. Immigrants from western Polynesia reached the Society group and explored northward from it until they rediscovered Hawaii. There they found a branch of the same people who had been modified by long isolation and so were able to establish themselves as overlords without meeting with serious opposition. They brought to Hawaii a few features of culture which they had acquired during their passage through southeastern Polynesia. In southeastern Polynesia the pressure of the invasion from the west forced some of the population to migrate to northern New Zealand and the southern Marquesas. These migrants were predominantly Caucasian and negroid in race but were probably under the direction of chiefs descended from the earlier Indonesian invaders of southeastern Polynesia. In New Zealand they destroyed the earlier Indonesian population or drove it into the undesirable localities. In the Marquesas they ousted the earlier population from the southern islands of the group but were unable to conquer the northern islands. After the departure of these emigrants from southeastern Polynesia, western Polynesian immigrants established themselves in the region, destroying or modifying the earlier type of culture.

The conditions in Polynesia are extremely complex, and the migration theory just outlined and the theory of the derivation of all the historic Polynesian cultures from three original cultures which were introduced by different races probably err on the side of simplicity. The division of Oceania into Polynesia, Micronesia and Melanesia is, in some respects, an arbitrary one and no final settlement of Polynesian problems will be possible until we have further information on the other two areas. Ingenious theories of cultural stratification have been advanced to account for the historic conditions in Melanesia, but Micronesia is still almost unknown scientifically and has been largely ignored by Polynesian students. Even our present fragmentary knowledge of Micronesia indicates that at least one of the Polynesian races passed through that region. A systematic study of Micronesian culture and physical type would no doubt provide a key to many of the Polynesian problems.

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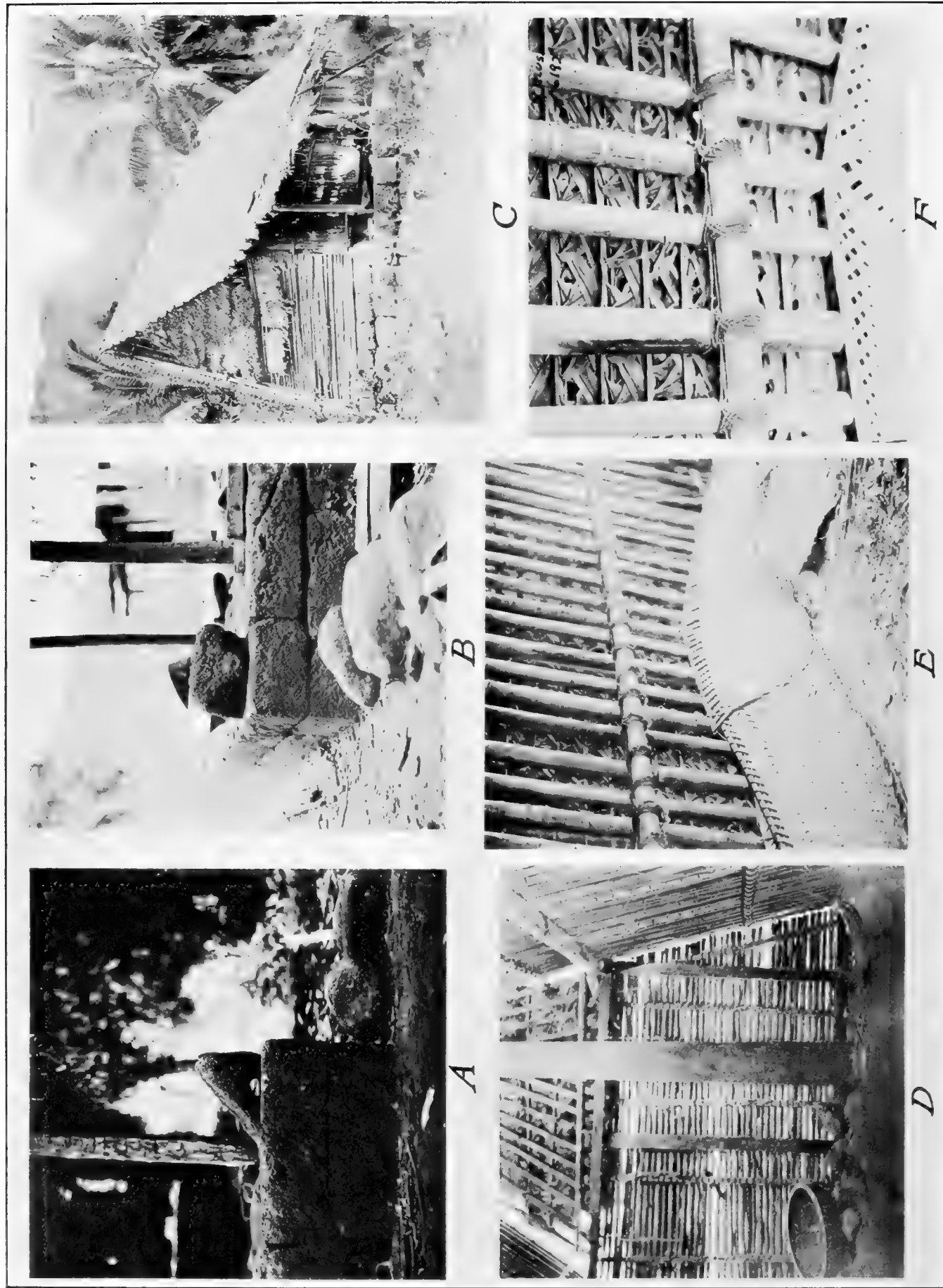
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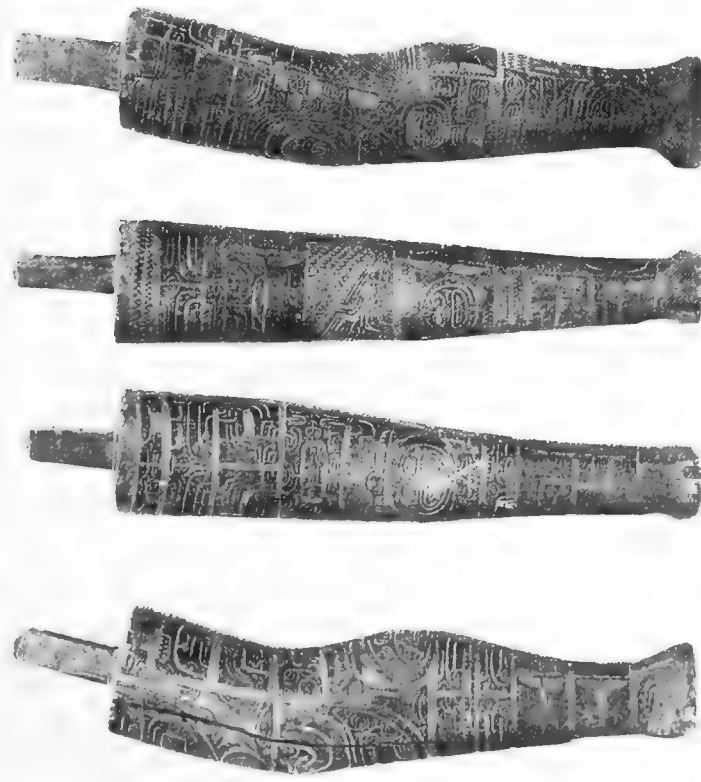
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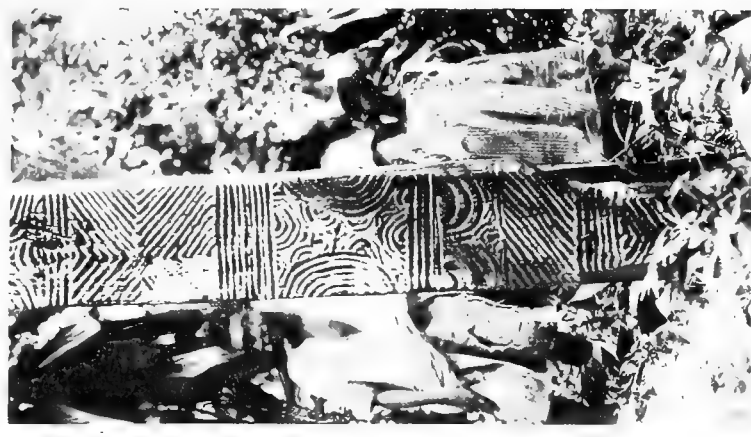
HOUSE CONSTRUCTION AND FURNISHINGS: *A*, BACK REST, SIDE VIEW; *B*, BACK REST, REAR VIEW; *C*, OLD HOUSE AT ATUONA, HIVA OA; *D*, FURNISHINGS AND CONSTRUCTION OF END WALL; *E*, CLOSE VIEW OF BED; *F*, ORNAMENTAL LASHINGS OF REAR ROOF.



A



B



C

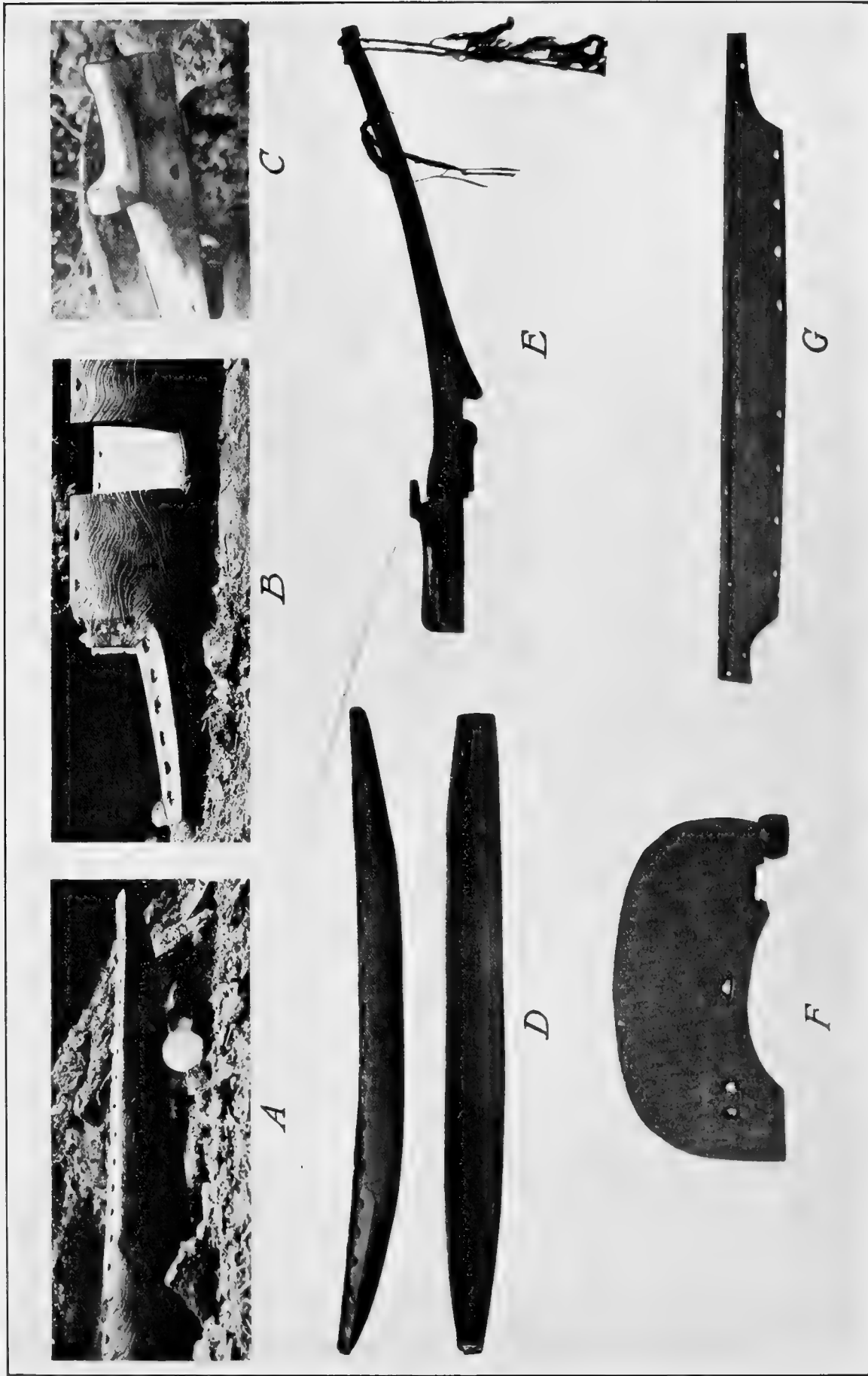


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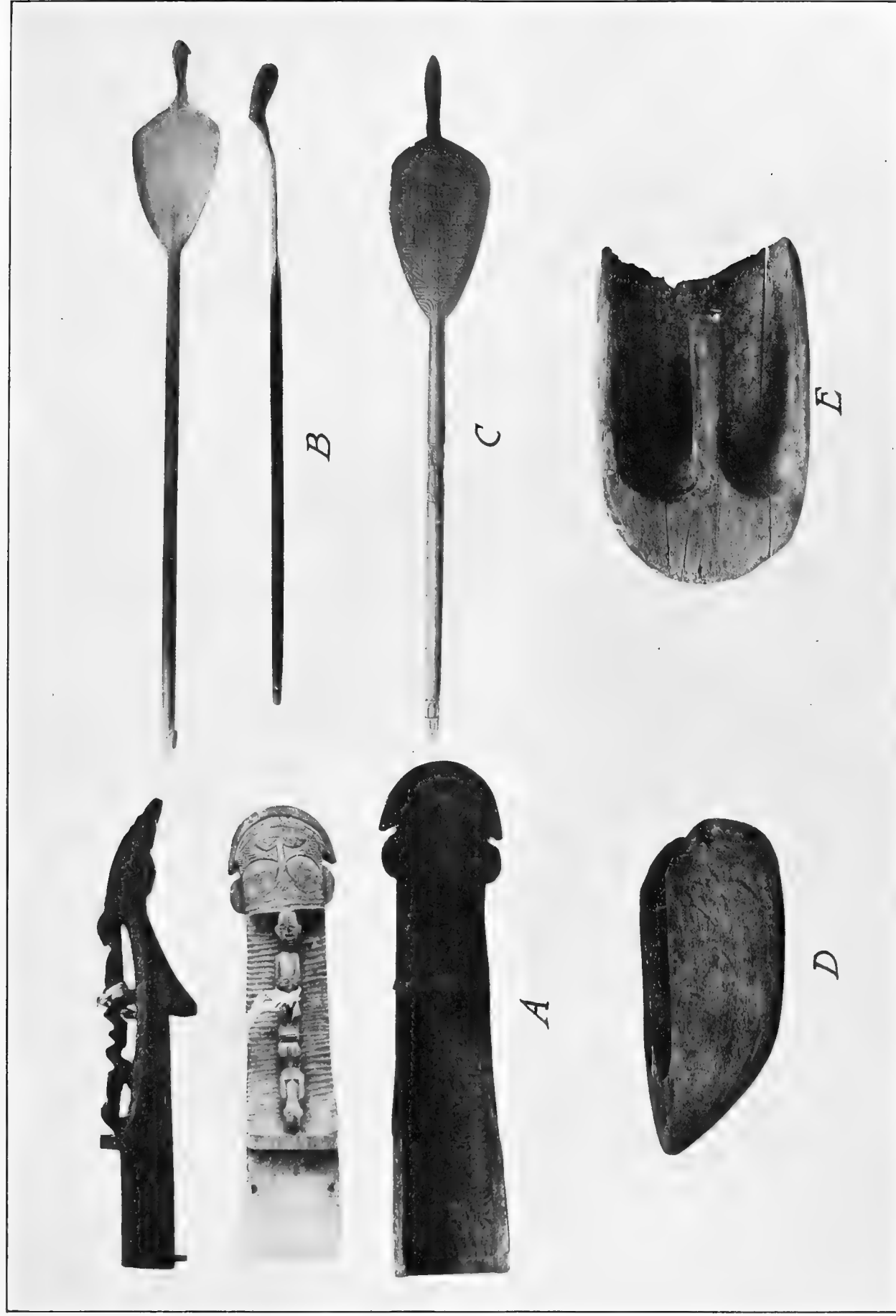


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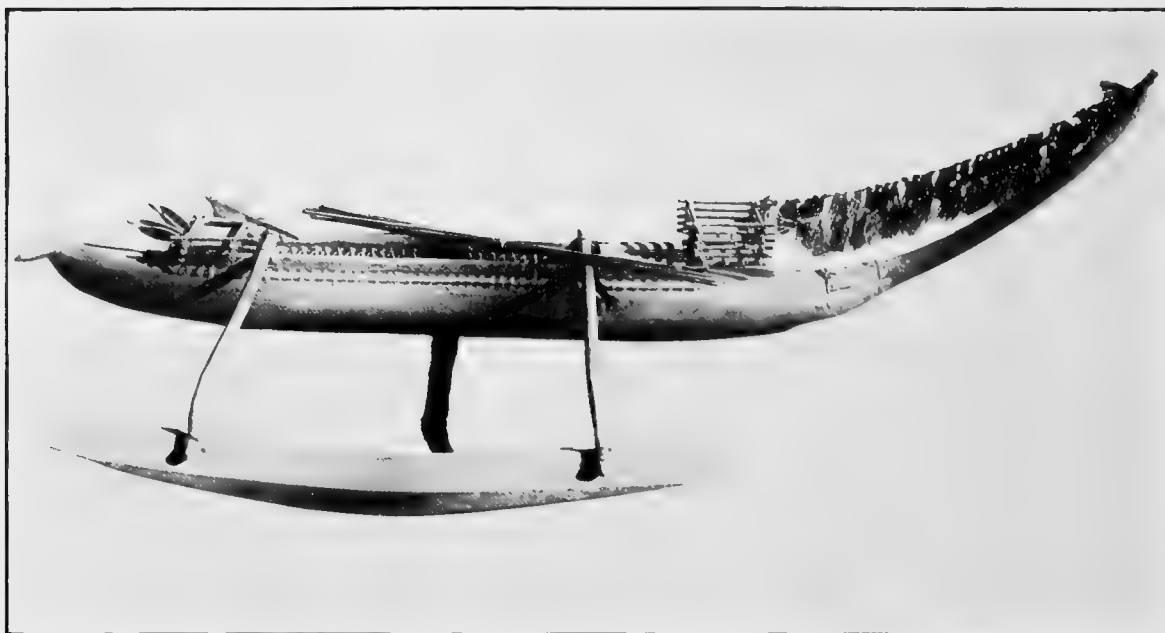
HOUSE DECORATIONS: A, WOODEN LEGS WITH TATTOO DESIGNS, PROBABLY USED FOR BED; B, ATLANTID HOUSE POST, FROM SACRED HOUSE ON ISLAND OF UA HUKA; C, CARVED HOUSE POST, ISLAND OF HIVA OA; D, E, STONE FIGURES FROM DWELLING PAEPAE IN PUA MA'U, HIVA OA.



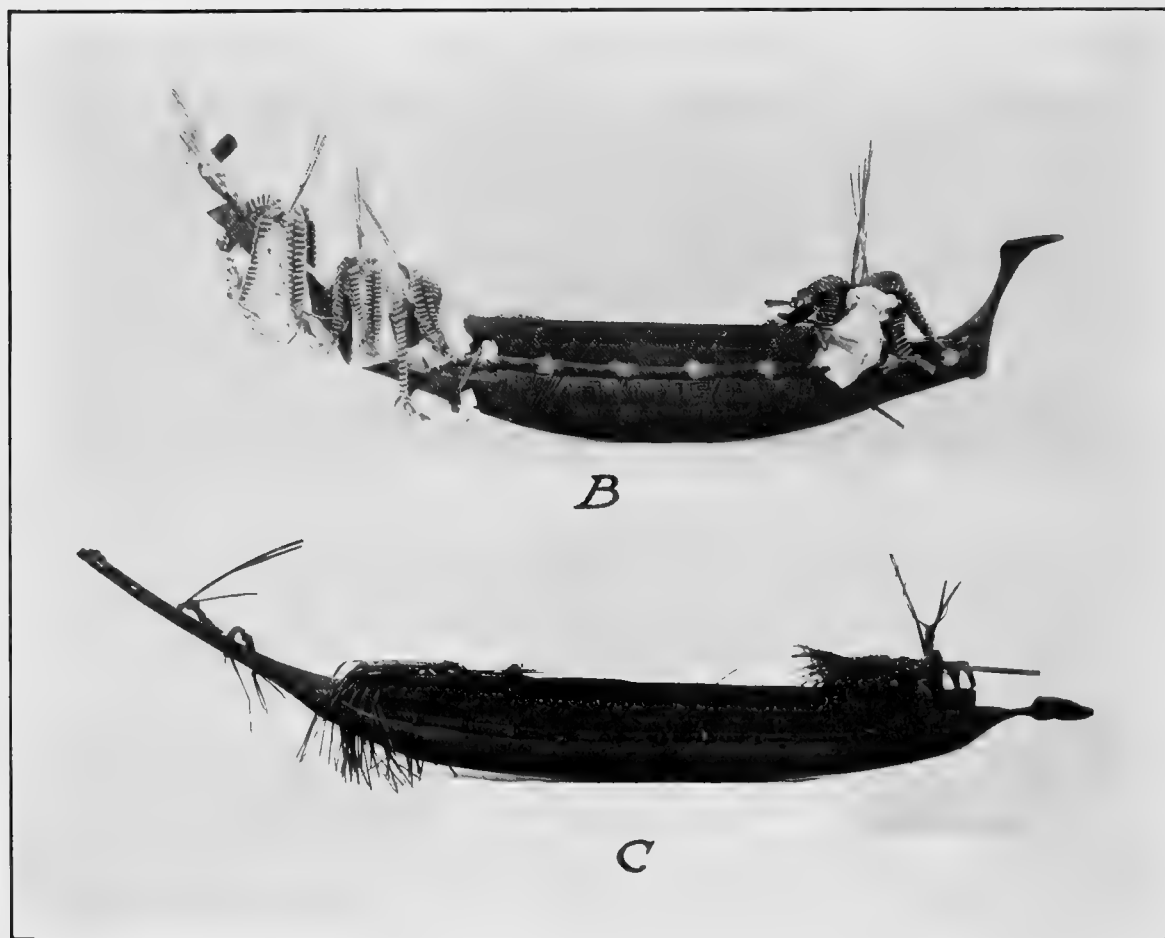
THE MARQUESAN CANOE: *A*, STERN; *B*, FORWARD END OF REAR SECTION OF UNDERBODY; *C*, STERN PIECE OF OLD CANOE; *D*, SIDE AND TOP VIEWS OF UNDERBODY OF OLD CANOE MODEL; *E*, STERN PIECE OF OLD CANOE MODEL; *F*, SUPPLEMENTARY BREAK-WATER; *G*, SIDE PLANK OF OLD CANOE MODEL.



CANOE PARTS AND EQUIPMENT: *A*, SIDE, TOP AND BOTTOM VIEWS OF BOW PIECE FROM OLD MODEL; *B*, REAR AND SIDE VIEWS OF ORDINARY PADDLE; *C*, MODERN CARVED PADDLE; *D* AND *E*, SIDE AND TOP VIEWS OF CANOE BAILER.



A



B

C

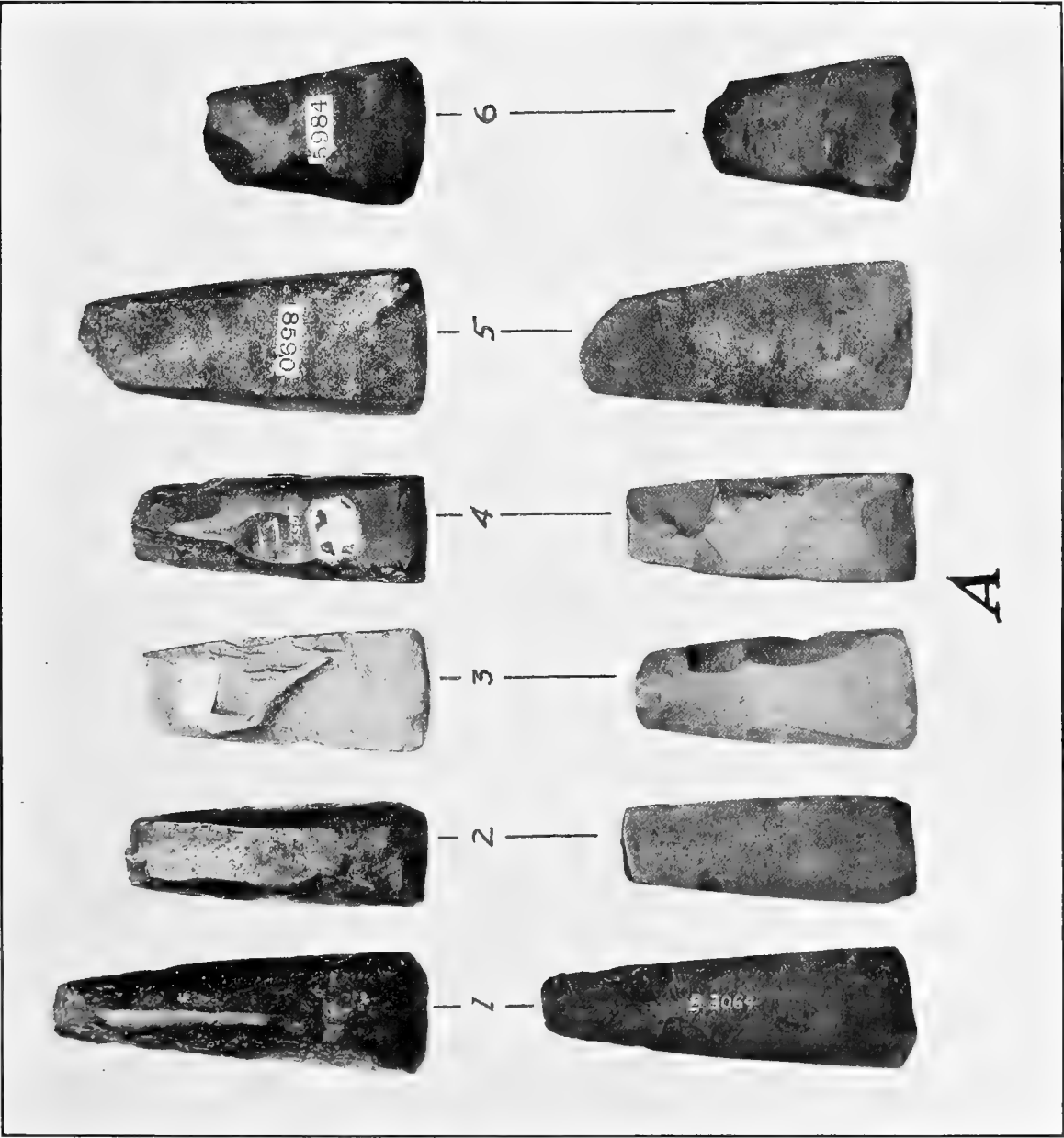
CANOE MODELS: *A*, VERY OLD MODEL (PEABODY MUSEUM, SALEM); *B*, MODERN MODEL, MADE FOR SALE; *C*, OLD MODEL, REPLICA OF ACTUAL CRAFT.



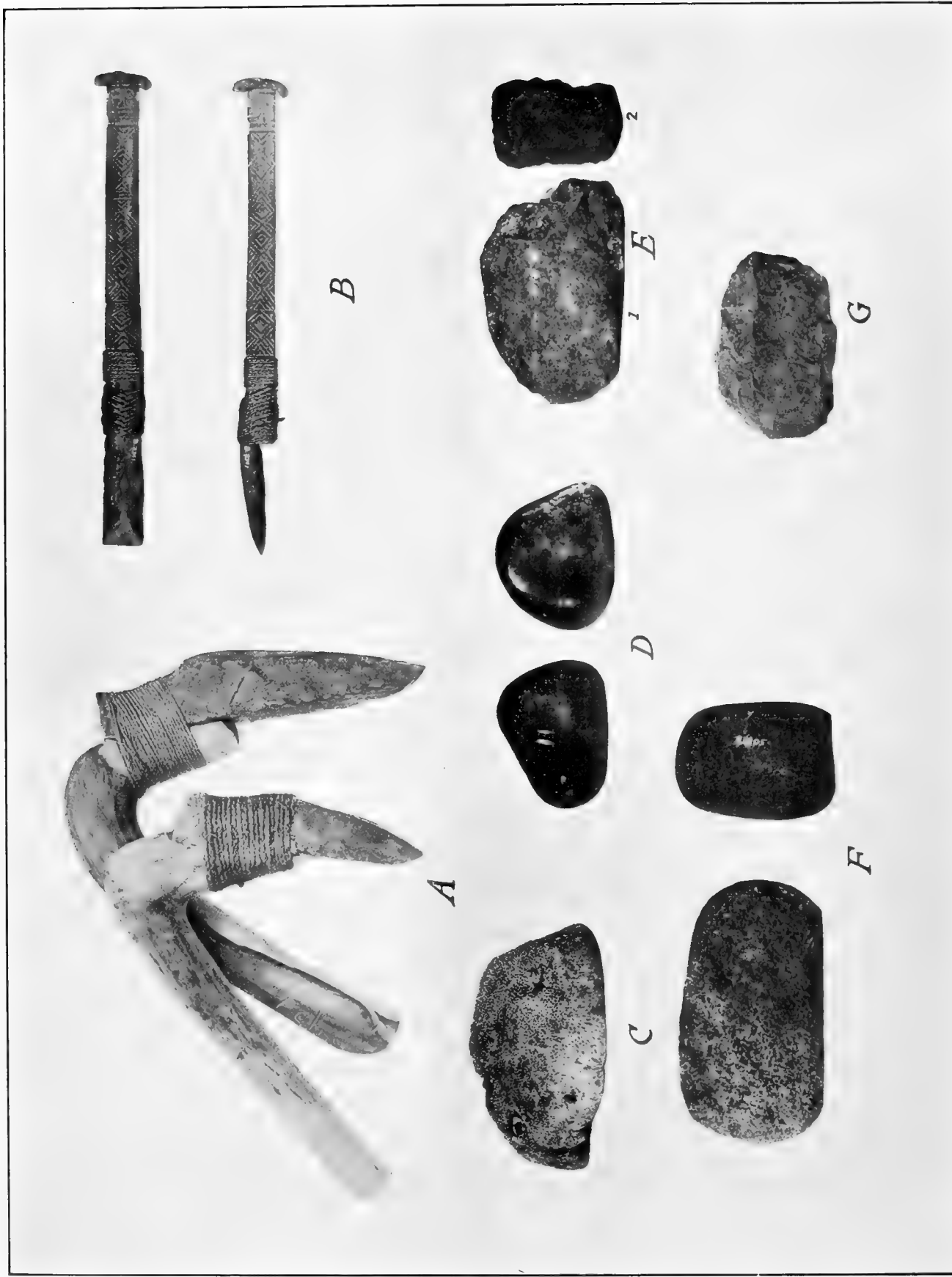
TANGED ADZES: *A*, FRONT VIEW; *B*, REAR VIEW; *C*, SIDE VIEW OF ADZES WITH TRIANGULAR CROSS SECTION; *D*, FRONT AND SIDE VIEWS OF ADZES WITH QUADRANGULAR CROSS SECTION; *E*, *F*, FRONT AND SIDE VIEWS OF ADZES OF TOKI AA TYPE; *G* AND *H*, ADZES OF TOKI KOUMA TYPE—FRONT, SIDE AND REAR VIEWS.



TANGLESS AND UNCLASSIFIED ADZES: *A*, TANGLESS ADZES, FRONT, SIDE, AND REAR VIEWS; *B*, UNCLASSIFIED ADZES, FRONT AND SIDE VIEWS—I, BISHOP MUSEUM NO. 6138; 2, BISHOP MUSEUM NO. 13075; 3, BISHOP MUSEUM NO. 13076; 4, BISHOP MUSEUM NO. 6147; 5, BISHOP MUSEUM NO. 13085.



A, TANGLESS ADZES OF POLYNESIA, FRONT AND REAR VIEWS: 1, MARQUESAS; 2, TONGA; 3, SAMOA; 4, EASTER ISLAND; 5, CHATHAM ISLANDS; 6, SOCIETY ISLANDS; B, MARQUESAN GOUGES.



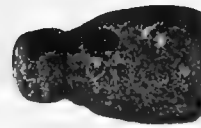
STONE IMPLEMENTS: *A*, HAFTED ADZES; *B*, HAFTED CHISEL, FRONT AND SIDE VIEWS; *C*, RUBBING STONE OF CORAL; *D*, RUBBERS USED TO POLISH WOOD; *E*, SCRAPPERS; *F*, HAMMER STONES; *G*, KNIFE.



A



B



C

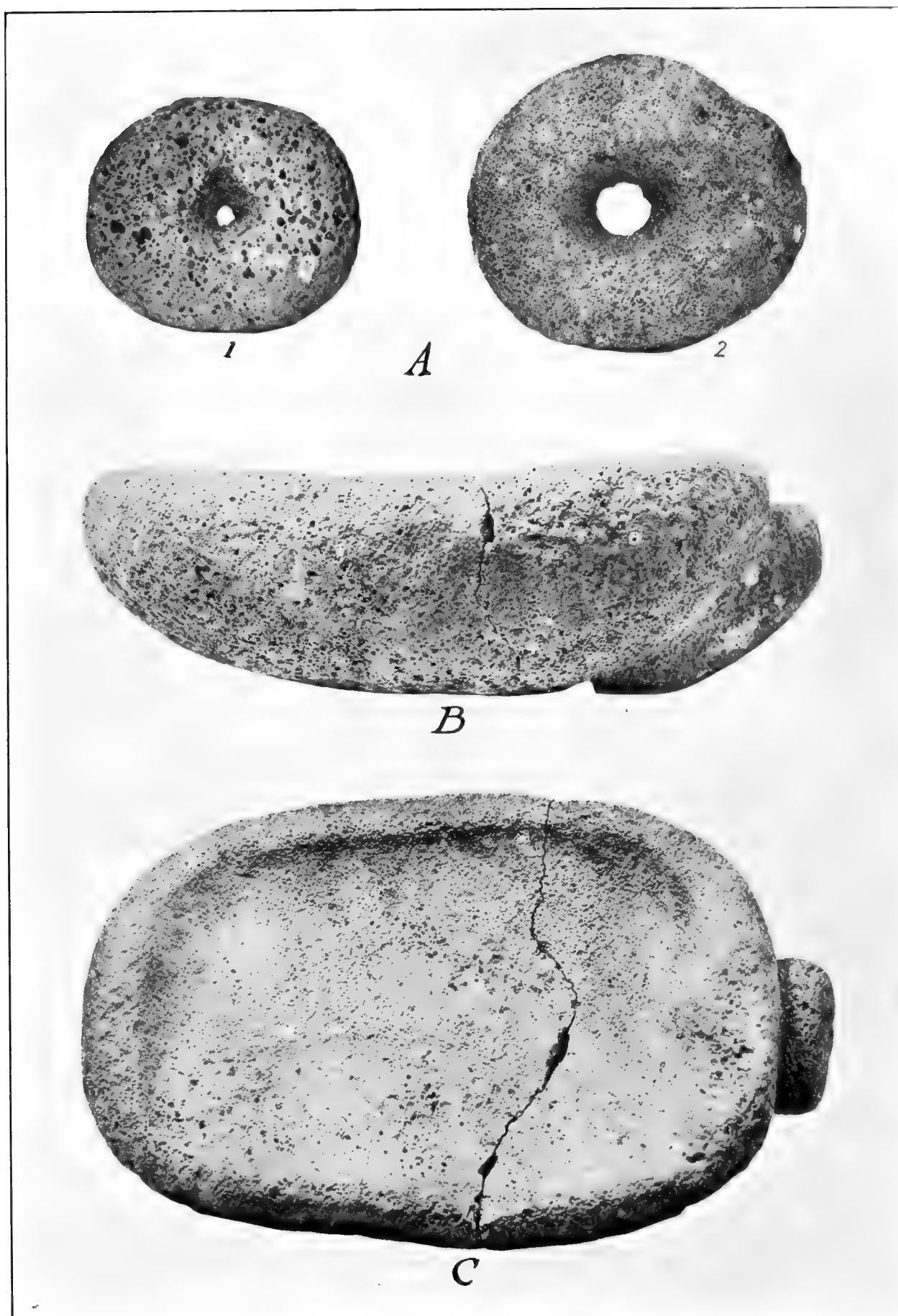


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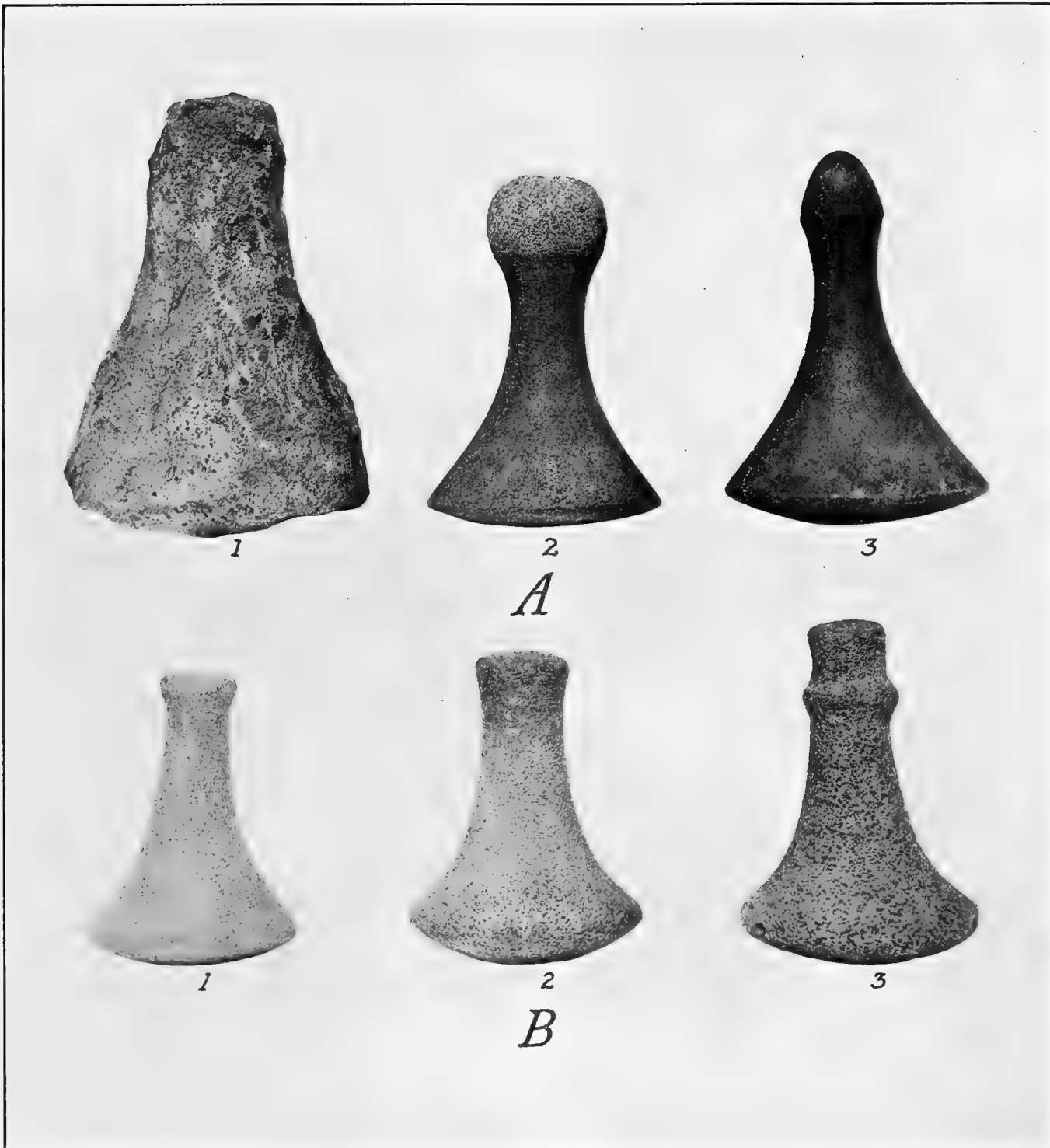


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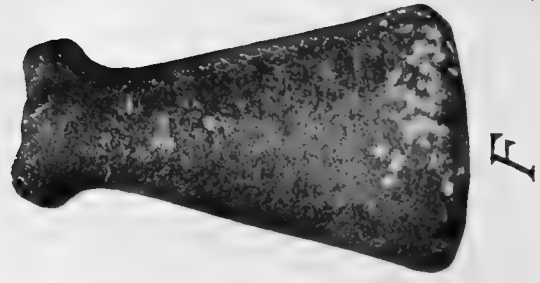
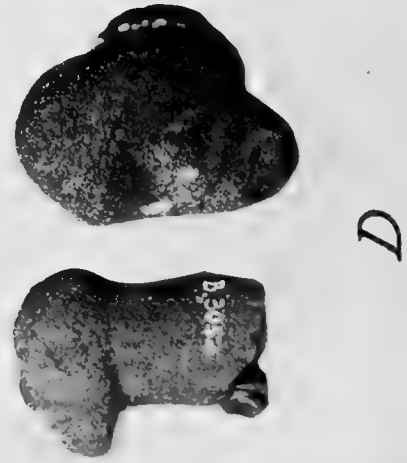
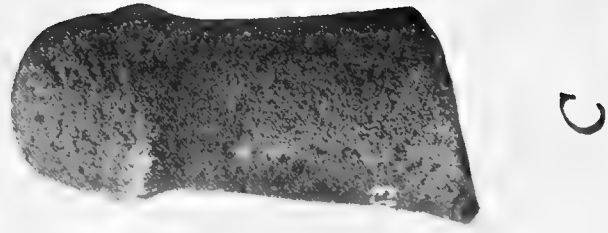
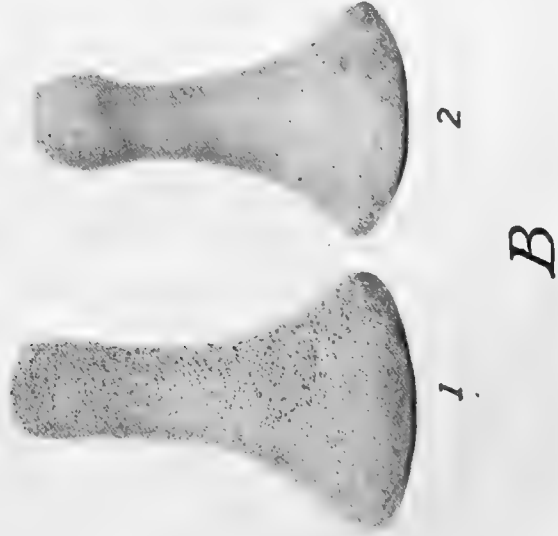
STONE ARTIFACTS AND UTENSILS: *A*, TOP VIEW; *B*, SIDE VIEW OF CARVED NET SINKER (UNIVERSITY MUSEUM, PHILADELPHIA); *C*, PIPE; *D*, EFFIGY PIPE, SIDE AND FRONT VIEWS; *E*, FRAGMENT OF DECORATED BOWL.



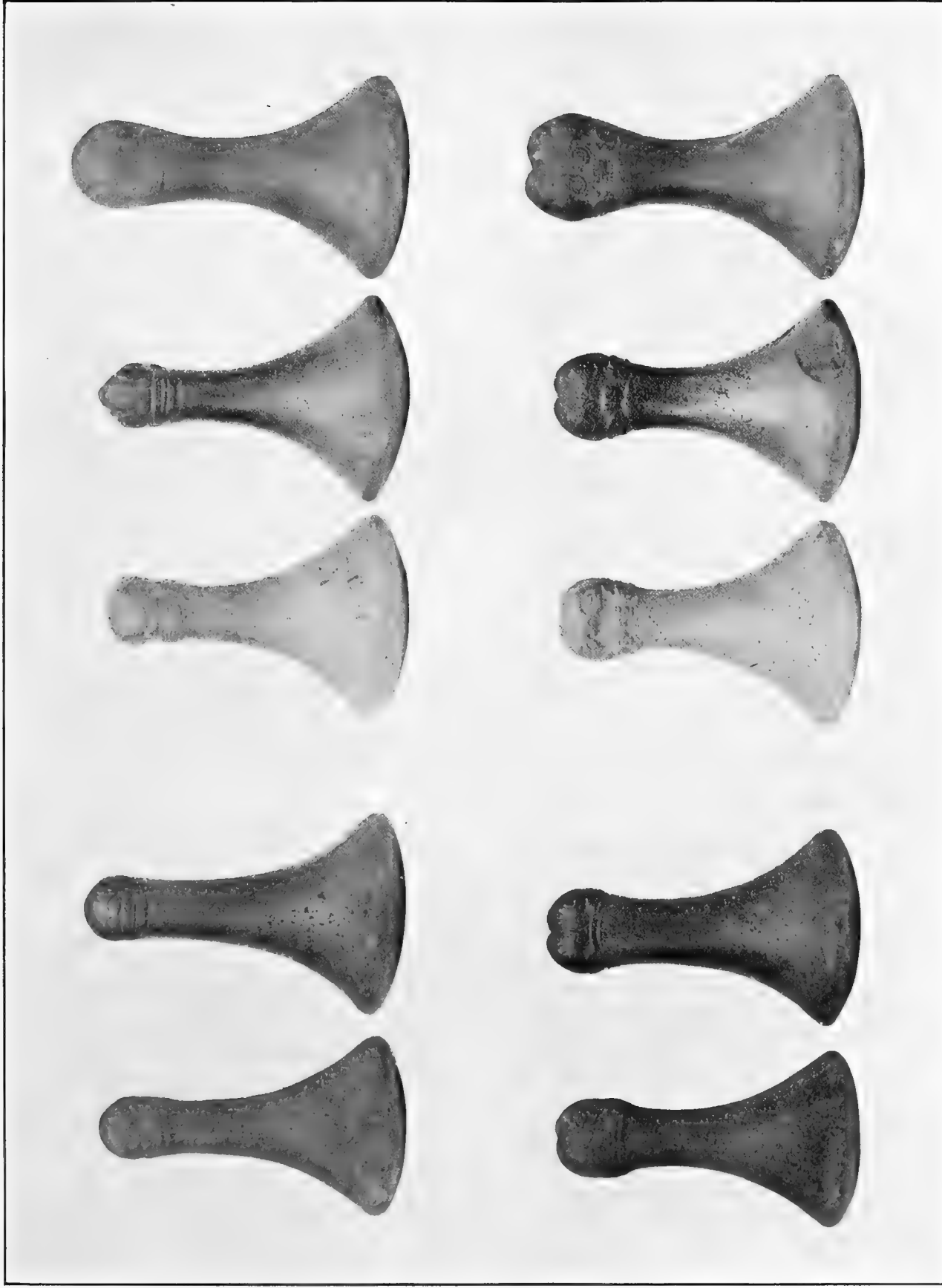
STONE ARTIFACTS AND UTENSILS: *A*, PERFORATED DISCS; *B* AND *C*, SIDE AND TOP VIEWS OF TRAY.



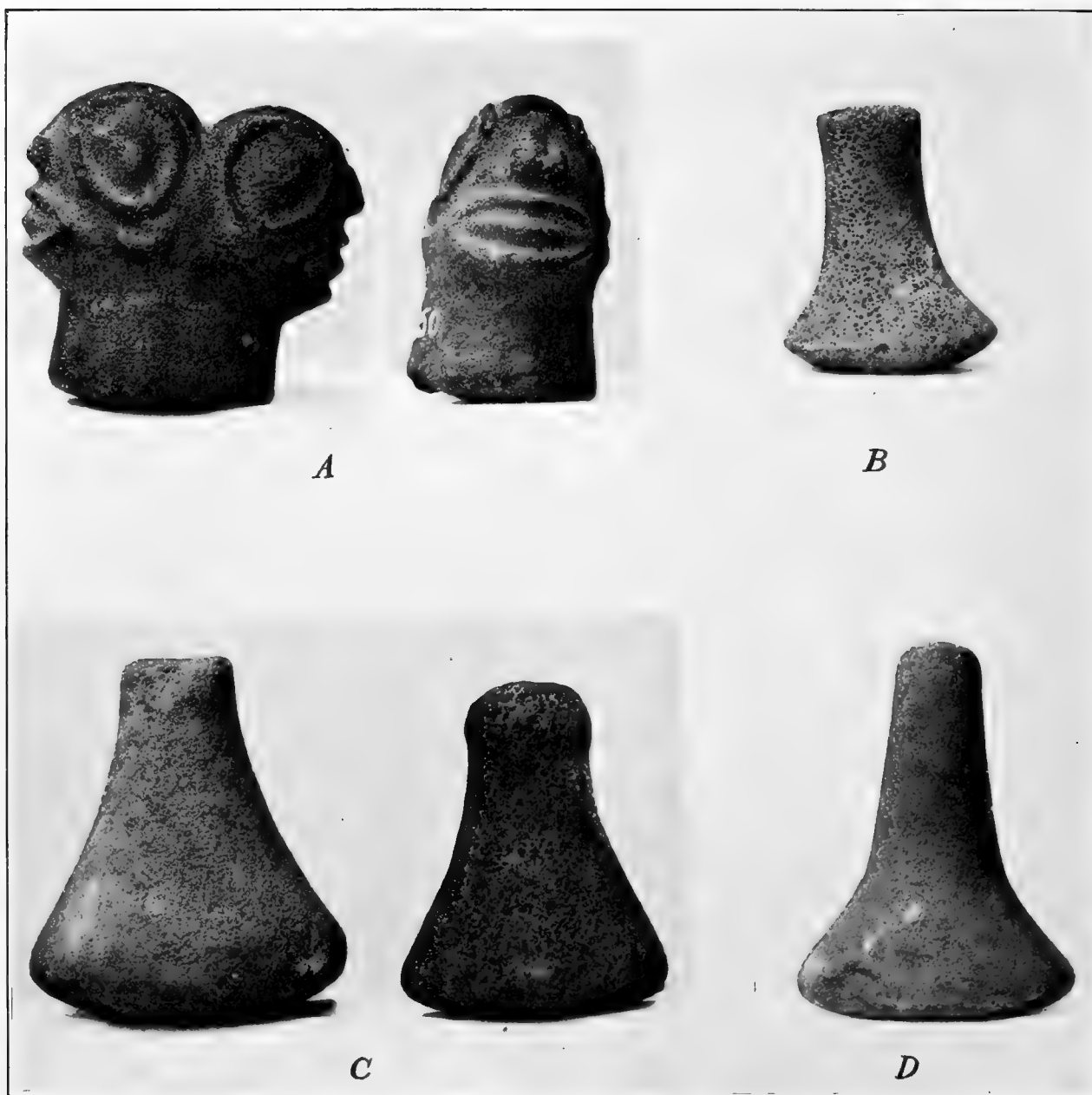
POPOI POUNDERS: *A*, MODERN COMMERCIAL POUNDERS FROM UA HUKA. FIGURE AT THE LEFT SHOWS FIRST STAGE OF MANUFACTURE; *B*, ANCIENT POUNDERS, OPU TYPE.



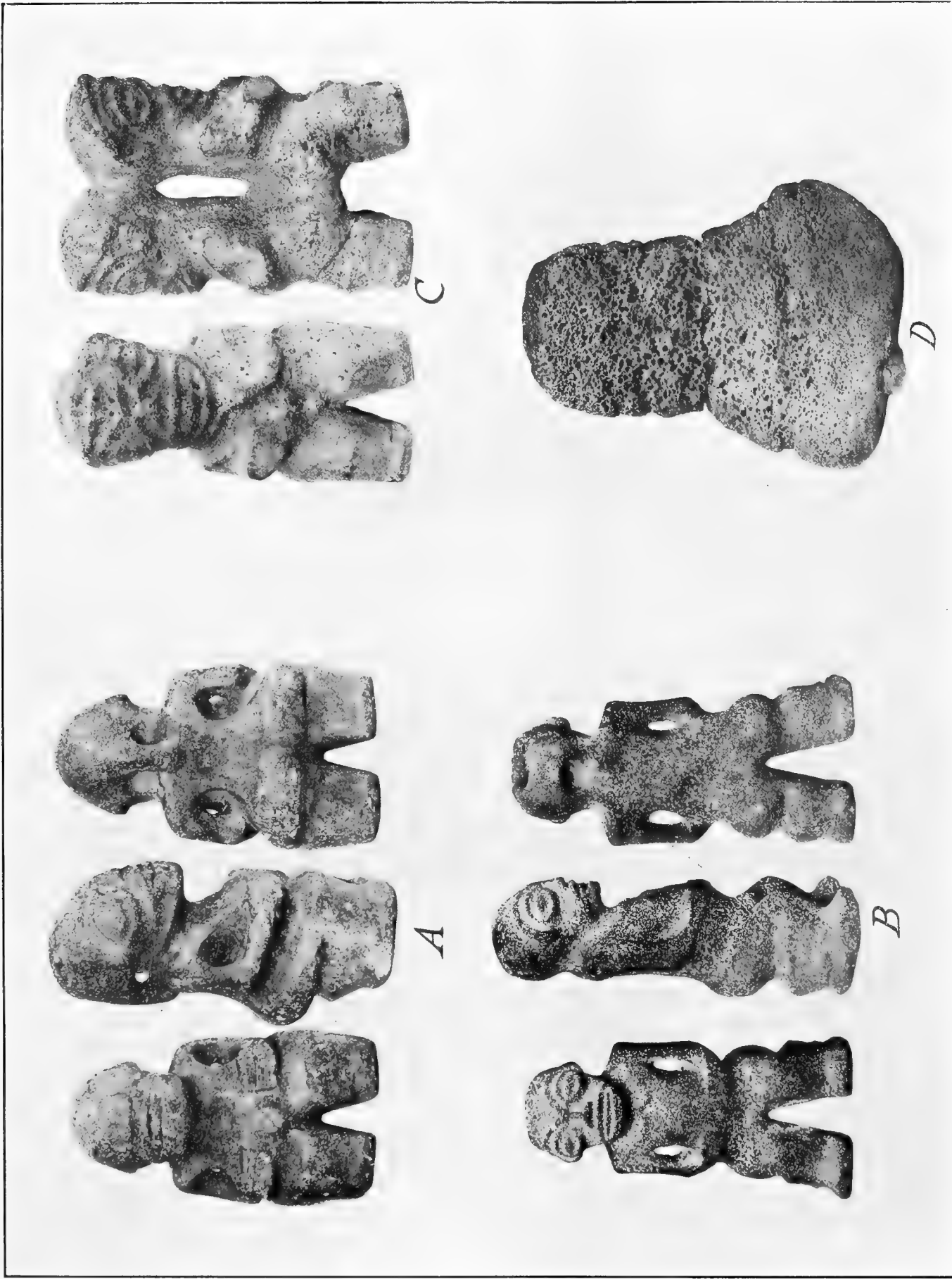
POPOI POUNDERS: *A*, PHALLIC POUNDERS OF NORMAL FORM, SIDE AND END VIEWS; *B*, PHALLIC POUNDERS OF UNUSUAL FORM; *C*, HEAD AND NECK OF PHALLIC POUNDER OF UNUSUAL FORM; *D*, HEAD AND NECK OF CONICAL POUNDER, SIDE AND TOP VIEWS; *E*, DOUBLE HEADED CONICAL POUNDER, SIDE AND TOP VIEWS; *F*, UNCARRVED CONICAL POUNDER.



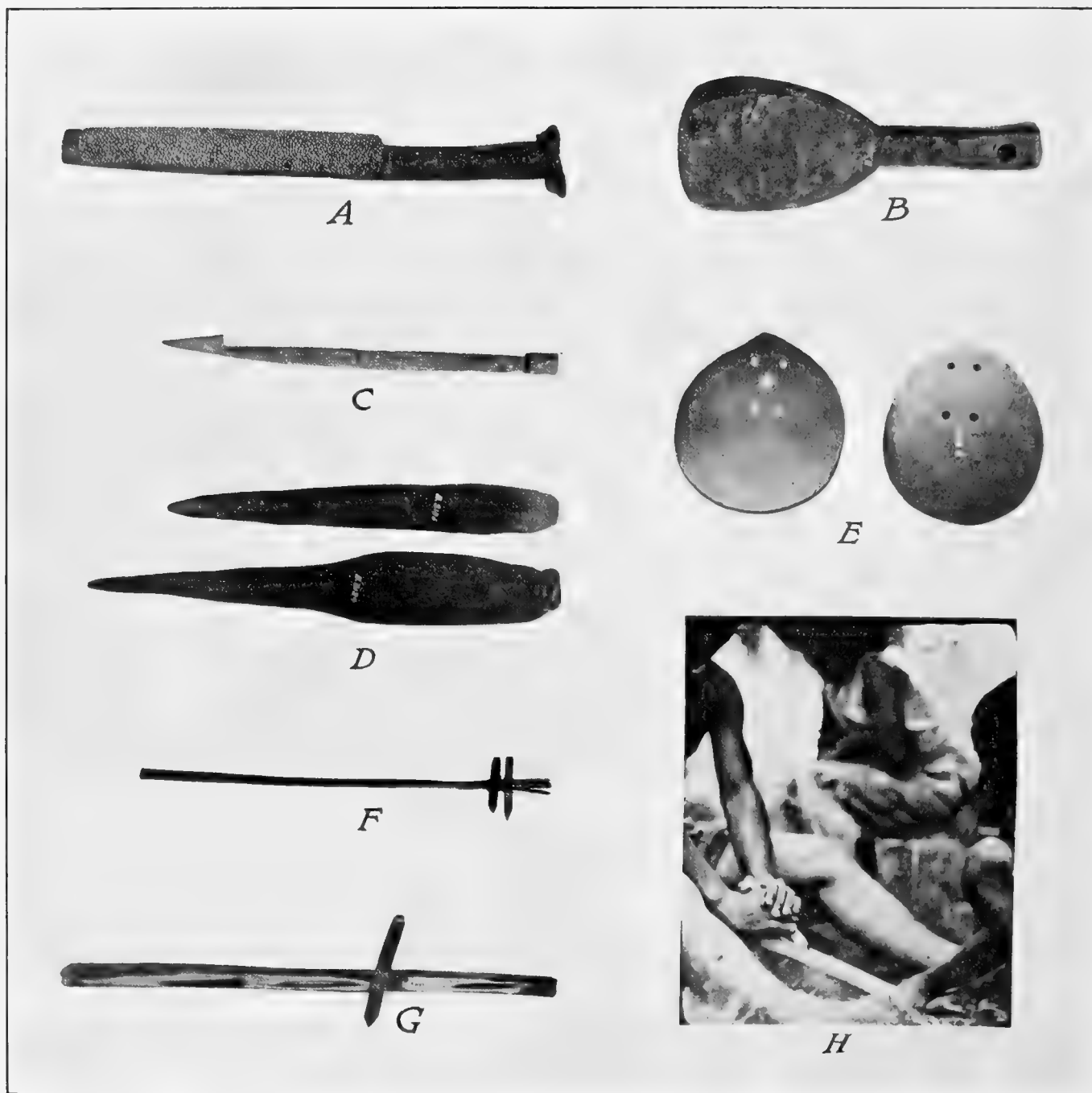
TIKI HEADED POPOI POUNDERS OF NORMAL TYPE, FRONT AND SIDE VIEWS.



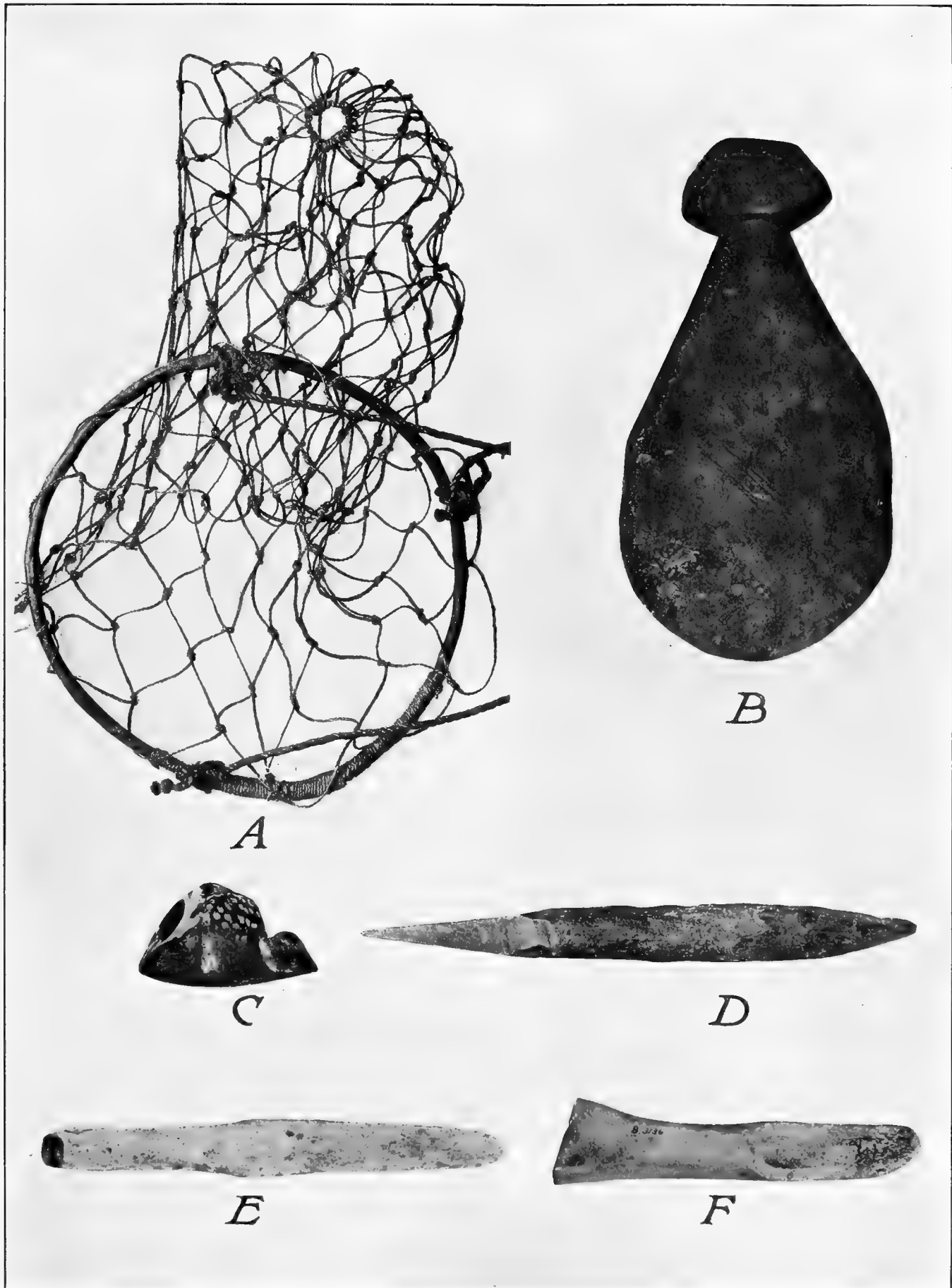
FOUNDERS: *A*, HEAD OF POUNDER OF UNUSUAL TYPE, FRONT AND SIDE VIEWS; *B*, CHILD'S POUNDER; *C*, POUNDERS FOR INFANTS' FOOD; *D*, SALT POUNDER.



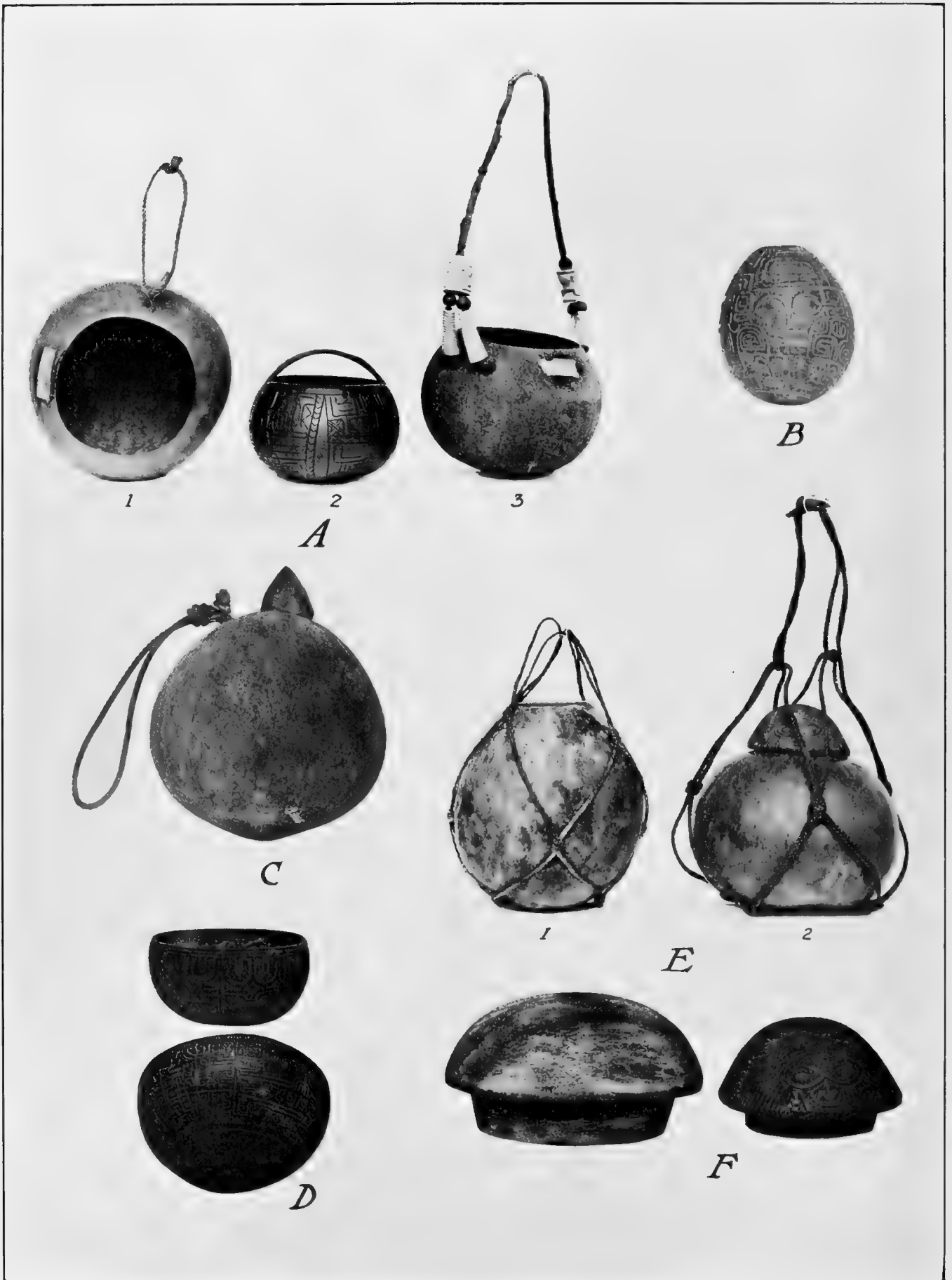
STONE CARVINGS: *A, B*, STONE FIGURES, FRONT, SIDE AND REAR VIEWS; *C*, DOUBLE FIGURE, FRONT AND SIDE VIEWS; *D*, OBJECT OF UNKNOWN PURPOSE, HEADS CARVED ON UPPER END.



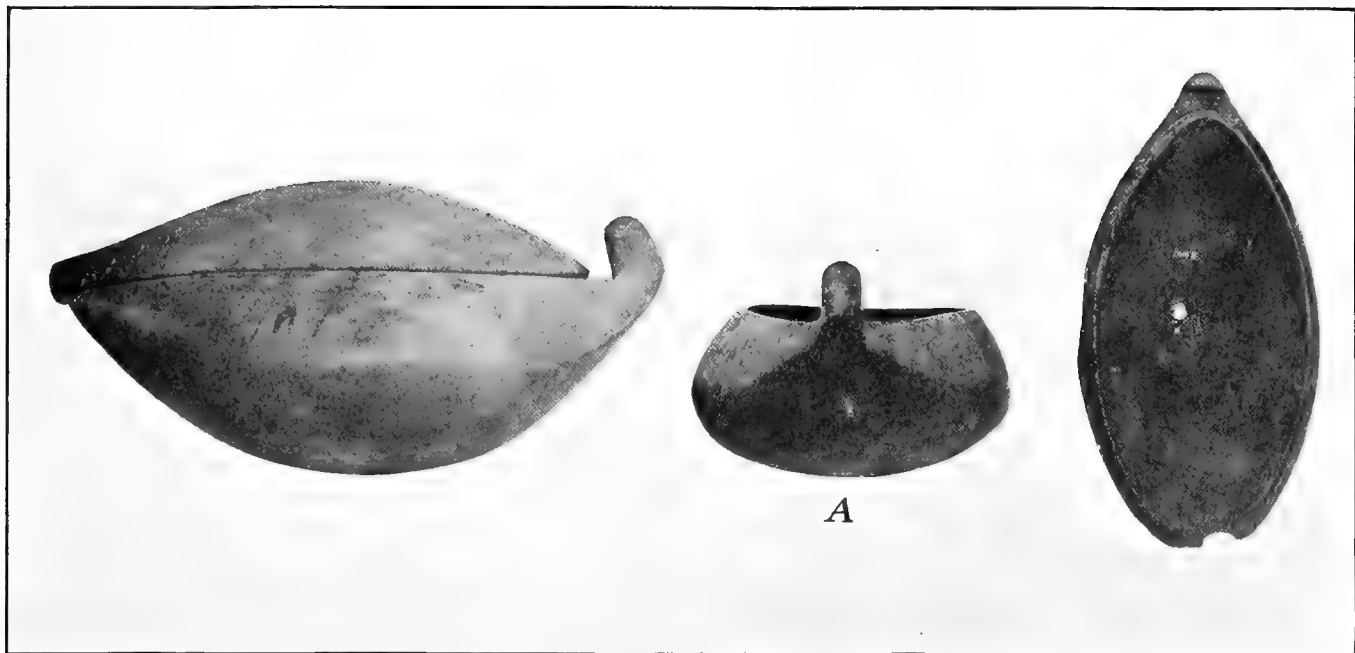
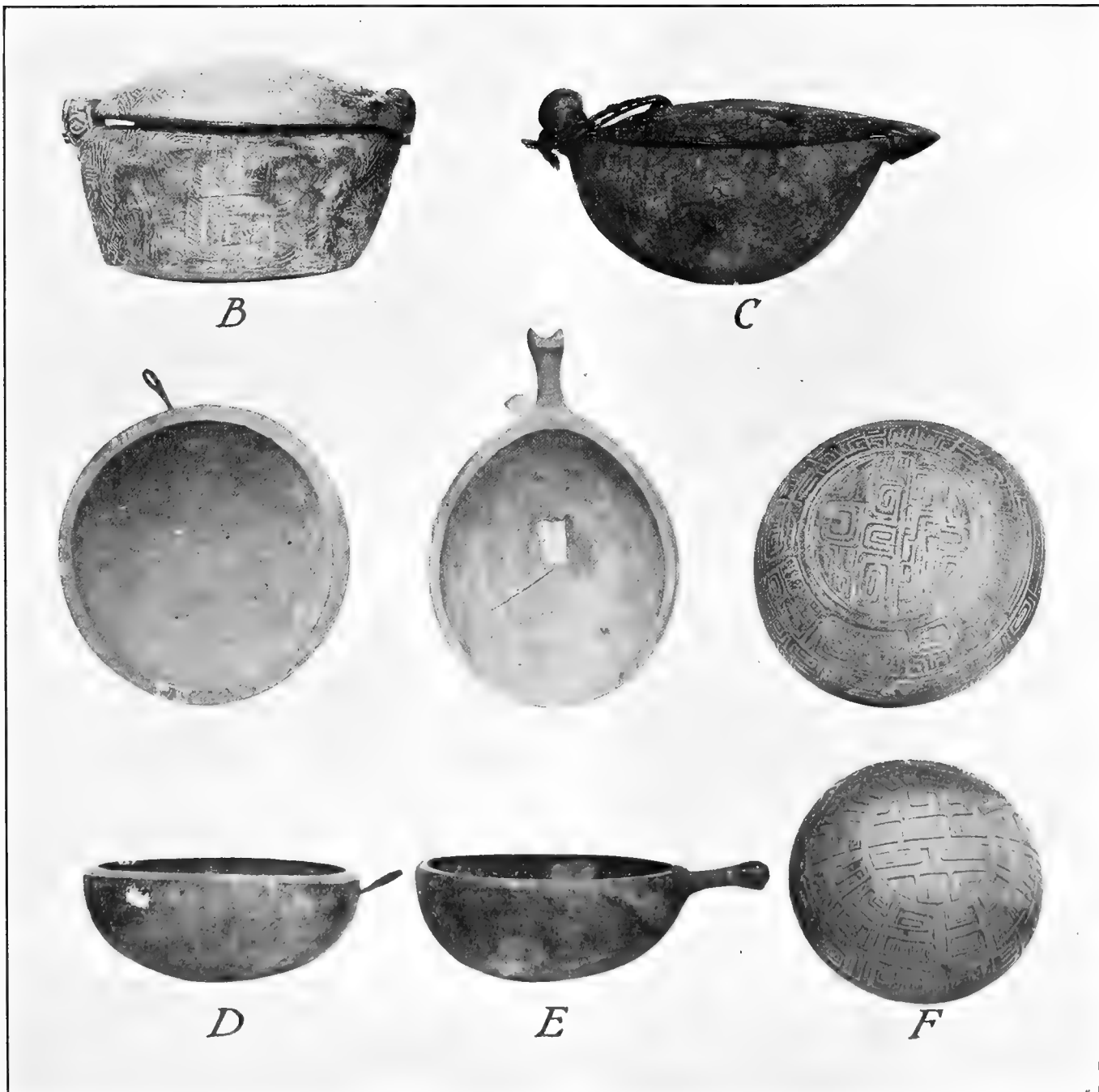
MISCELLANEOUS IMPLEMENTS: *A*, SHARK SKIN RASP; *B*, Mallet; *C*, THATCHING NEEDLE; *D*, TOOLS FOR MAKING COPRA; *E*, BOWLS OF LARGE SPOONS OR LADLES; *F*, COTTON SEED EXTRACTOR; *G*, FIRE STICKS; *H*, METHOD OF USING FIRE STICKS.



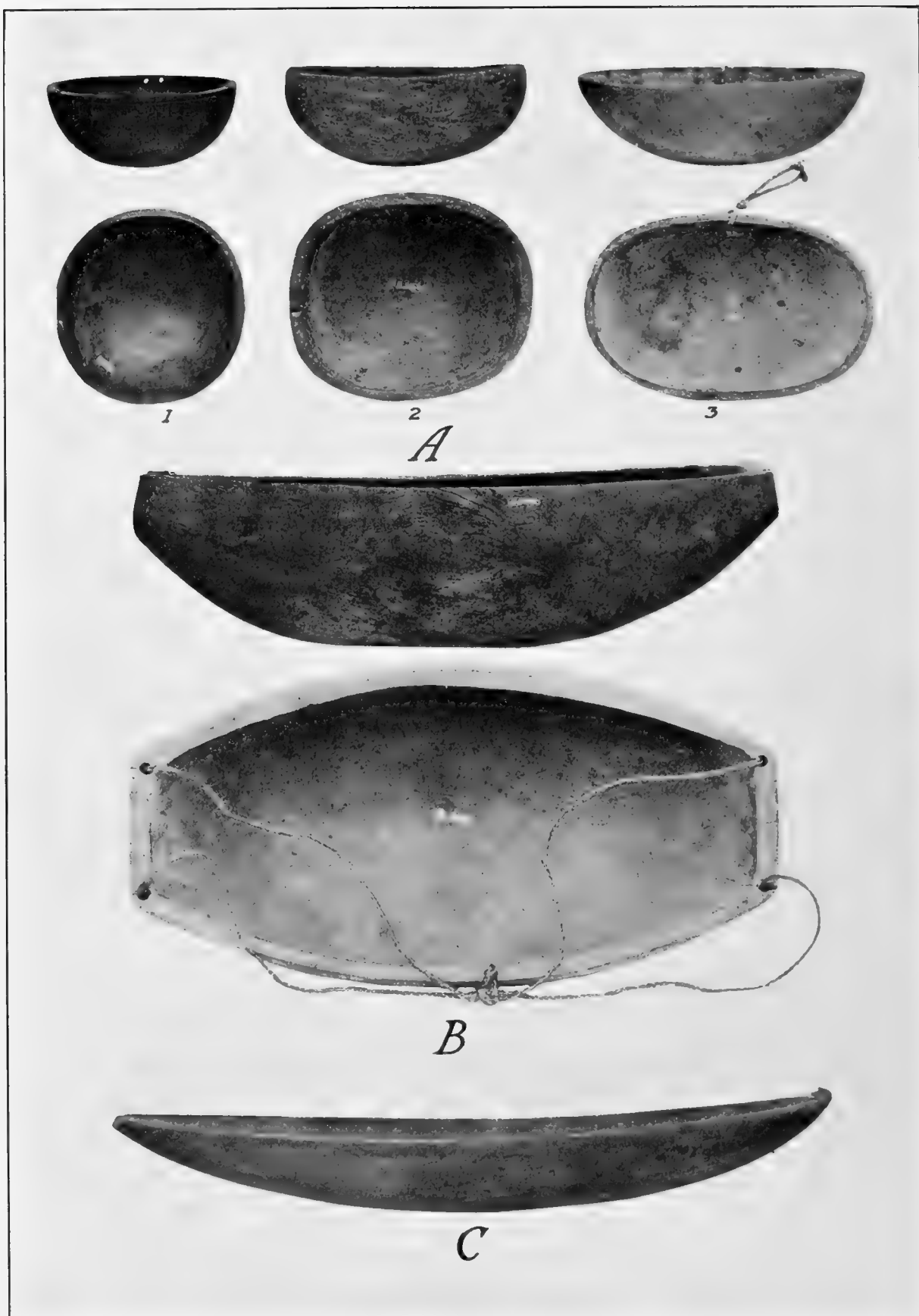
ARTICLES USED IN PREPARING BREADFRUIT: *A*, NET FOR CARRYING FRUIT; *B*, SPLITTER; *C*, PEELER; *D*, STICK FOR PIERCING FRUIT; *E*, WOODEN KNIFE; *F*, BONE KNIFE FOR PEELING COOKED FRUIT.



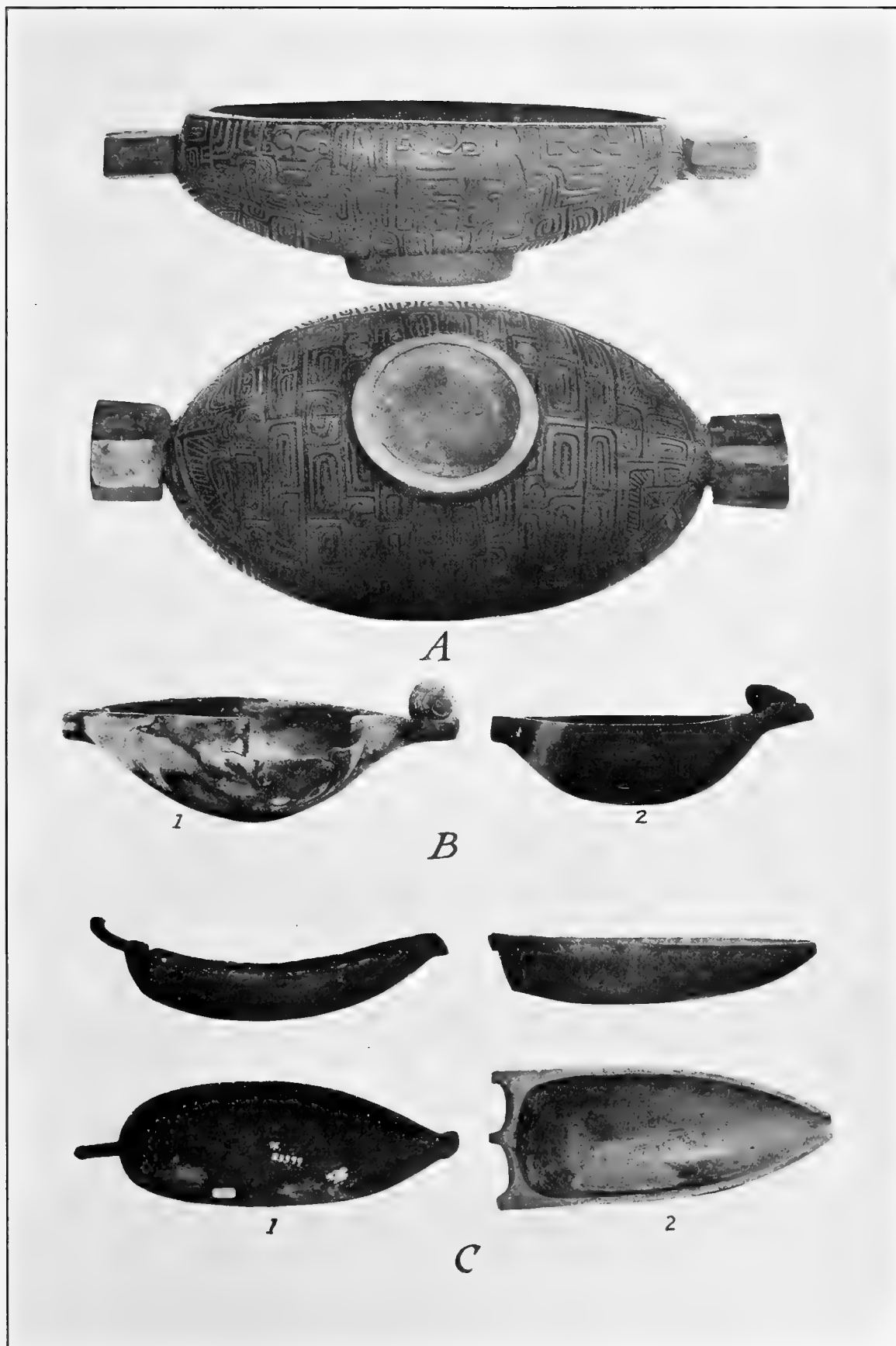
COCONUT SHELL AND GOURD CONTAINERS: *A*, COCONUT BOWLS — (1) WITH LOOP FOR SUSPENSION, (2) WITH HANDLE MADE FROM SHELL, (3) WITH DECORATED CORD HANDLE; *B*, COCONUT BOTTLE FOR OIL; *C*, COCONUT BOTTLE FOR WATER; *D*, CARVED COCONUT CUPS; *E*, GOURD CONTAINERS (HUE); *F*, STOPPERS FOR GOURD CONTAINERS.

*A*

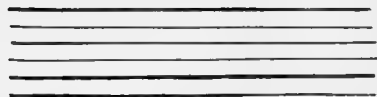
WOODEN CONTAINERS: *A*, LARGE BOX, VIEWS OF SIDE, END AND INSIDE OF LID; *B*, CARVED BOX, UNUSUAL FORM; *C*, SMALL BOX; *D*, BOWL WITH LOOP FOR SUSPENSION, TOP AND SIDE VIEWS; *E*, BOWL WITH HANDLE, TOP AND SIDE VIEWS; *F*, CARVED BOWLS, BOTTOM VIEWS.



WOODEN BOWLS AND TRAYS: *A*, BOWLS—(2) AND (3) KAVA BOWLS, TOP AND SIDE VIEWS; *B*, TOTO, SIDE AND TOP VIEWS; *C*, LARGE OVAL DISH OR TRAY.



WOODEN DISHES AND BOWLS: *A*, OVAL DISH WITH BASE, SIDE AND BOTTOM VIEWS; *B*, SMALL BOWLS; *C*, KAVA BOWLS OF UNUSUAL FORM, SIDE AND TOP VIEWS.



A



B



C



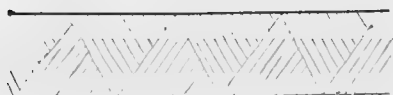
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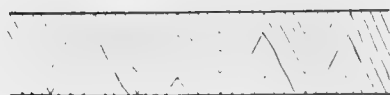
E



F



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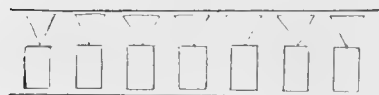
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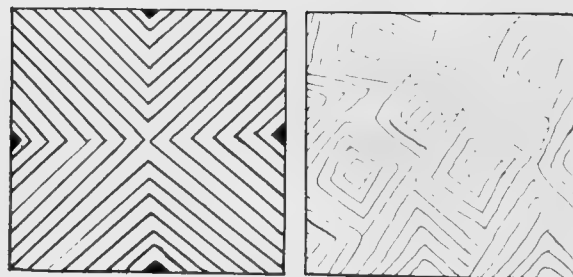
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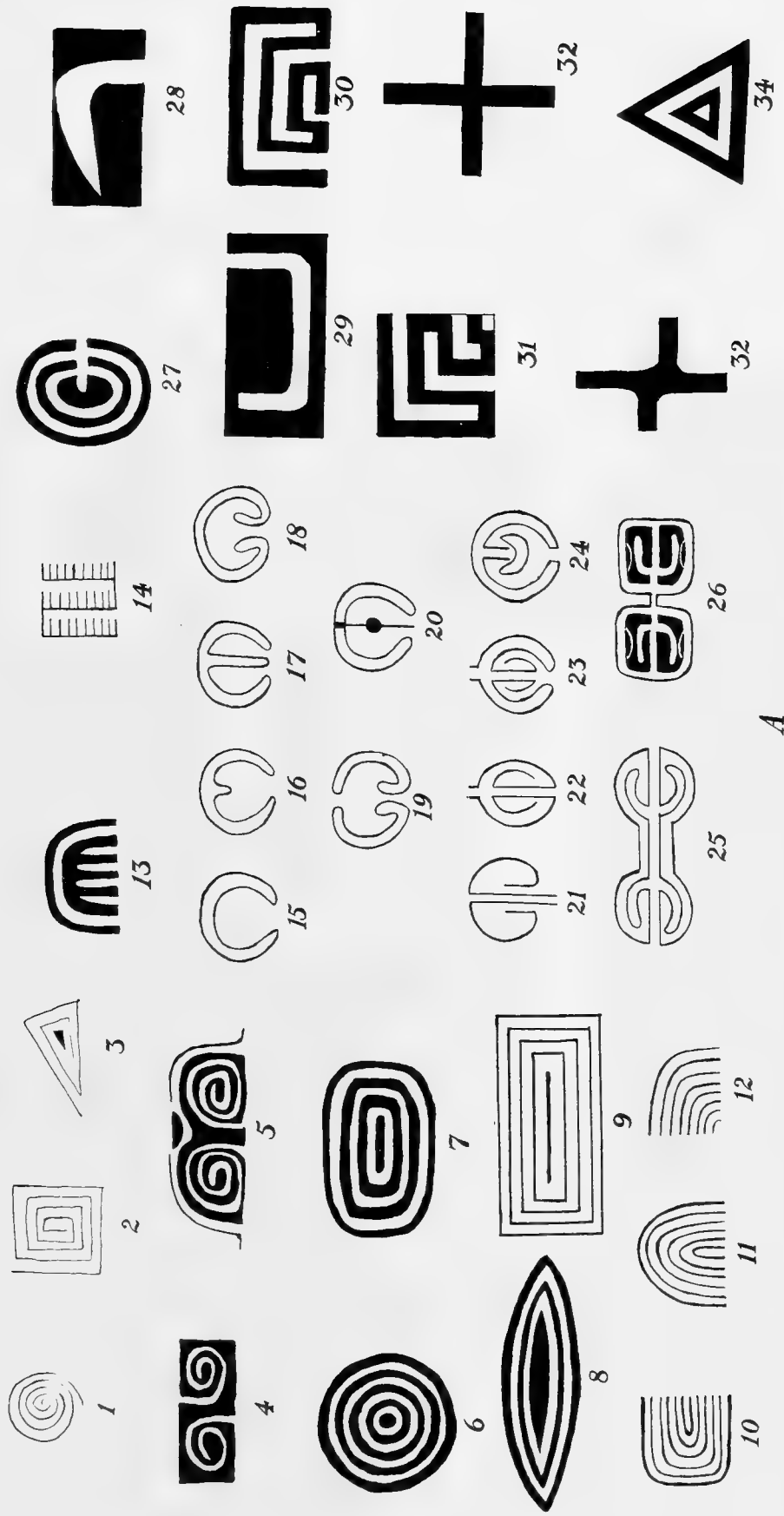


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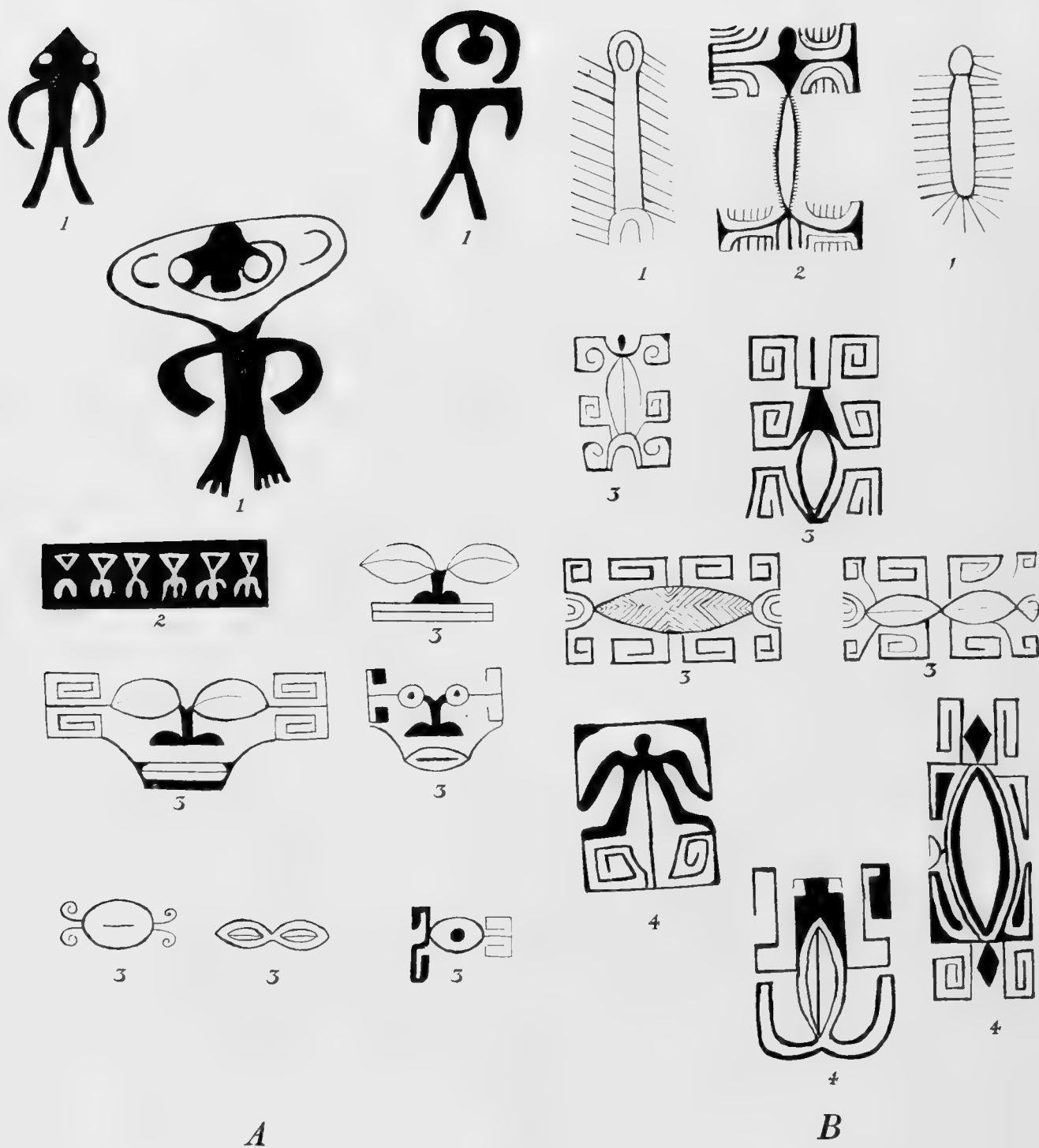


P

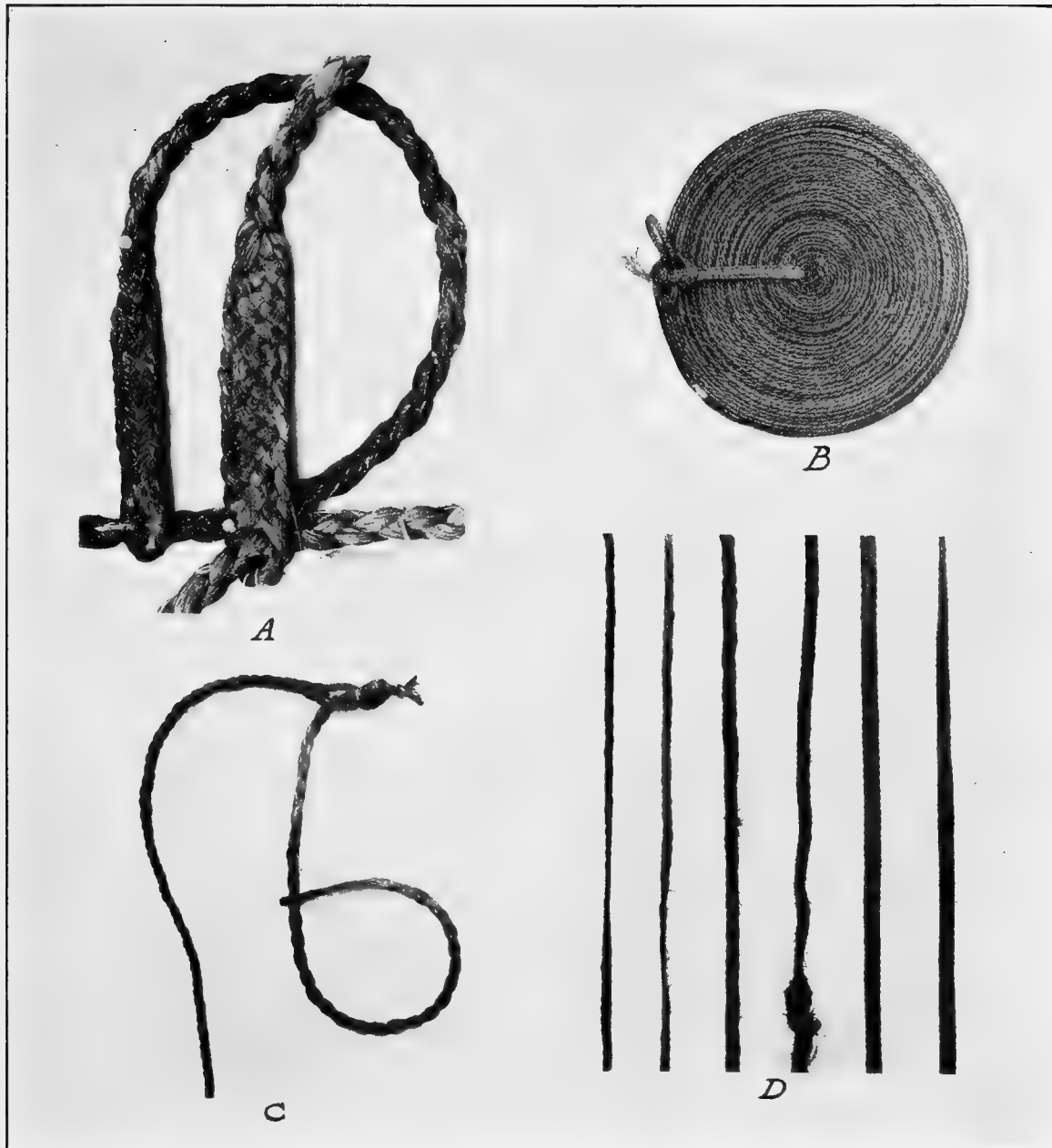
DESIGNS ON CONTAINERS: *A-O*, BAND DECORATIONS; *P*, *Q*, DESIGNS USED TO FILL SECTIONS.



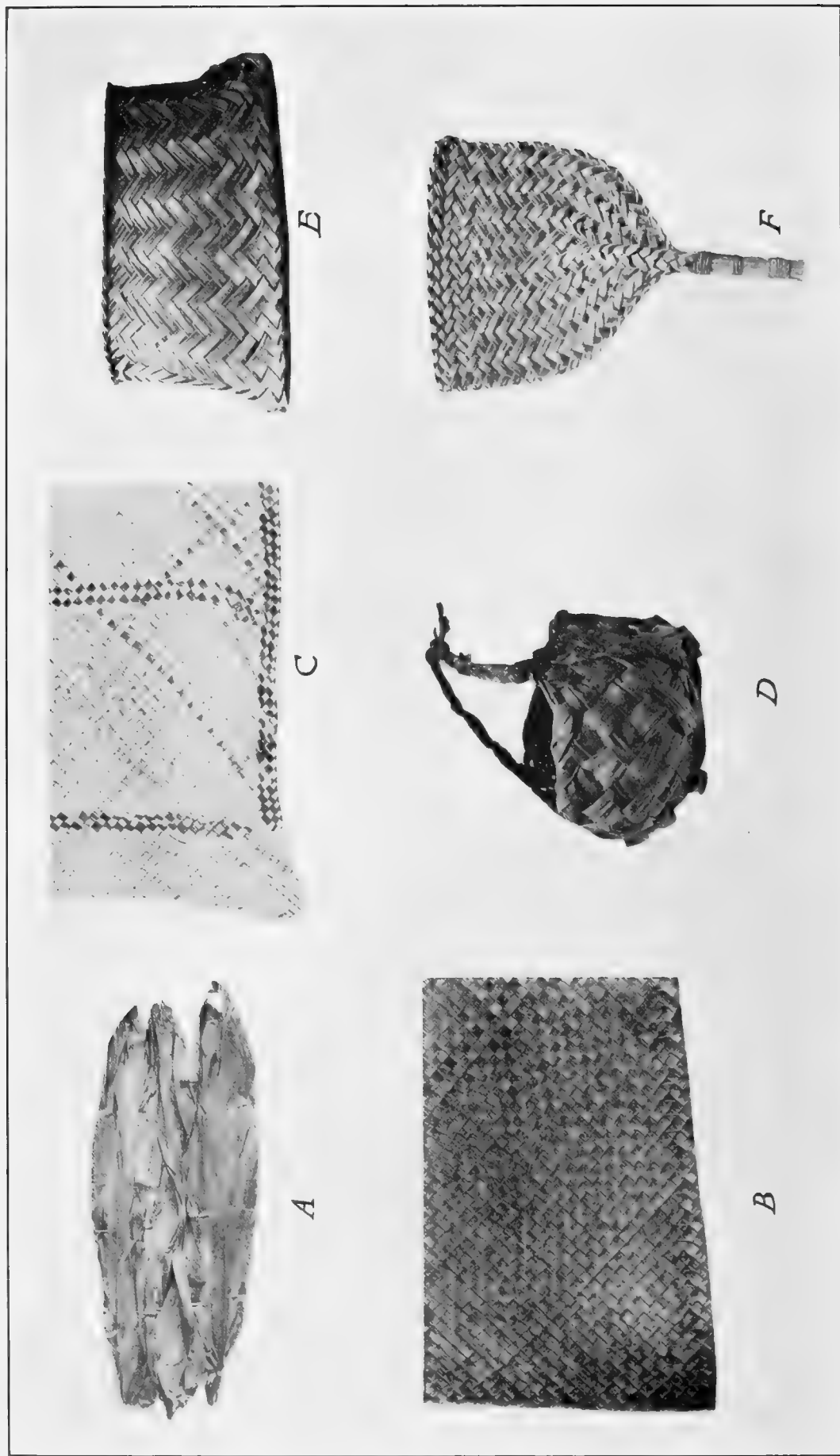
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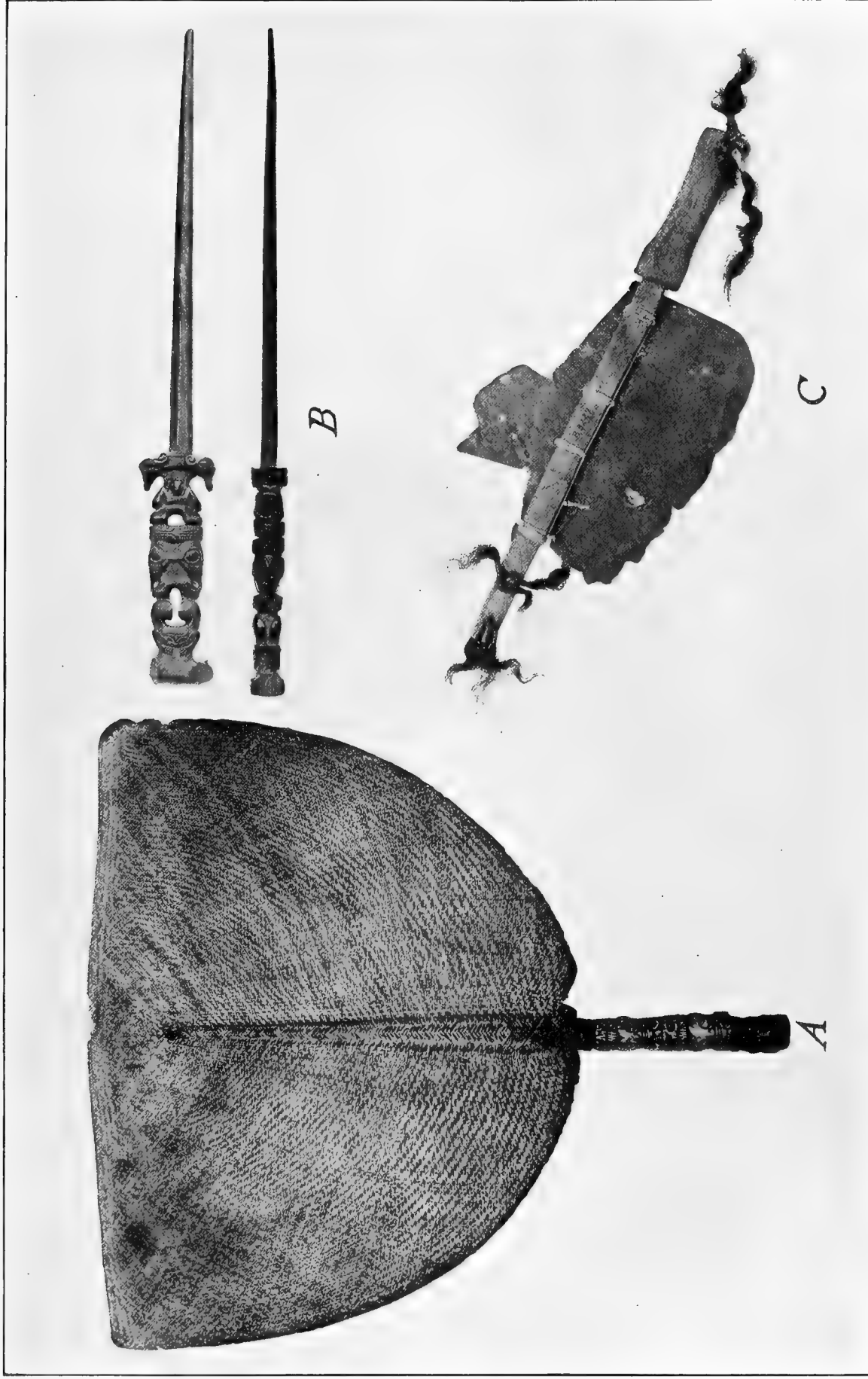
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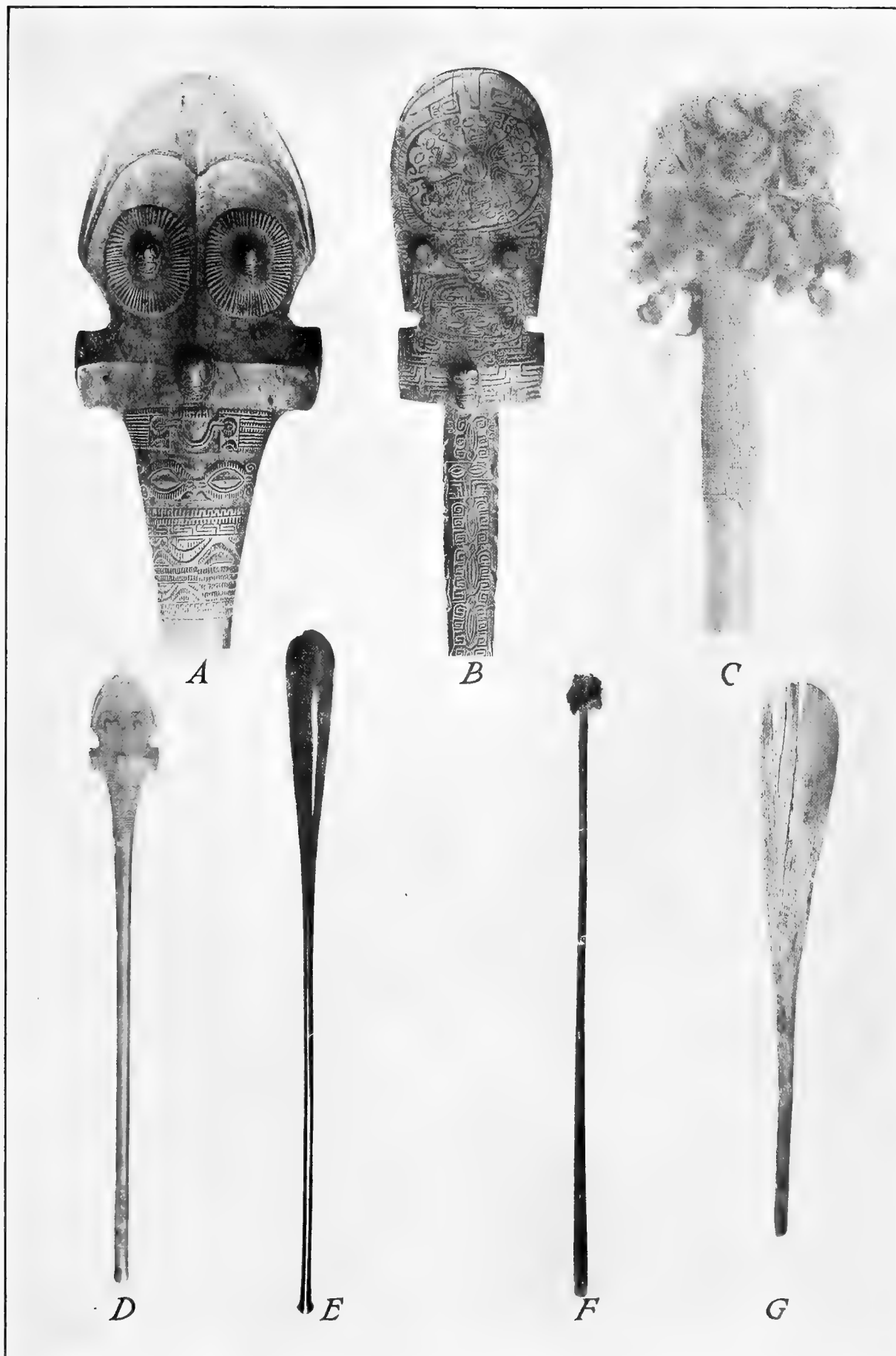
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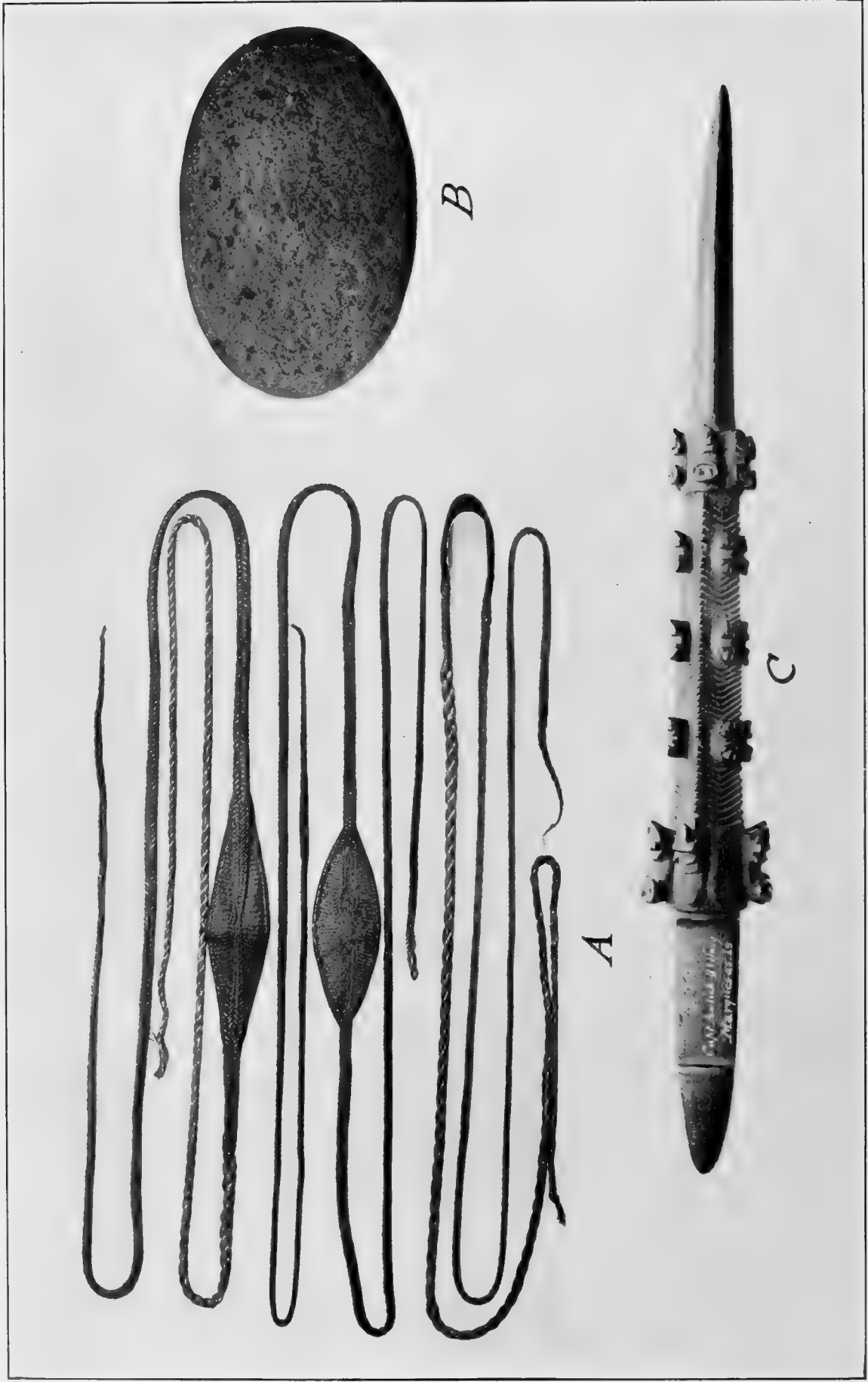
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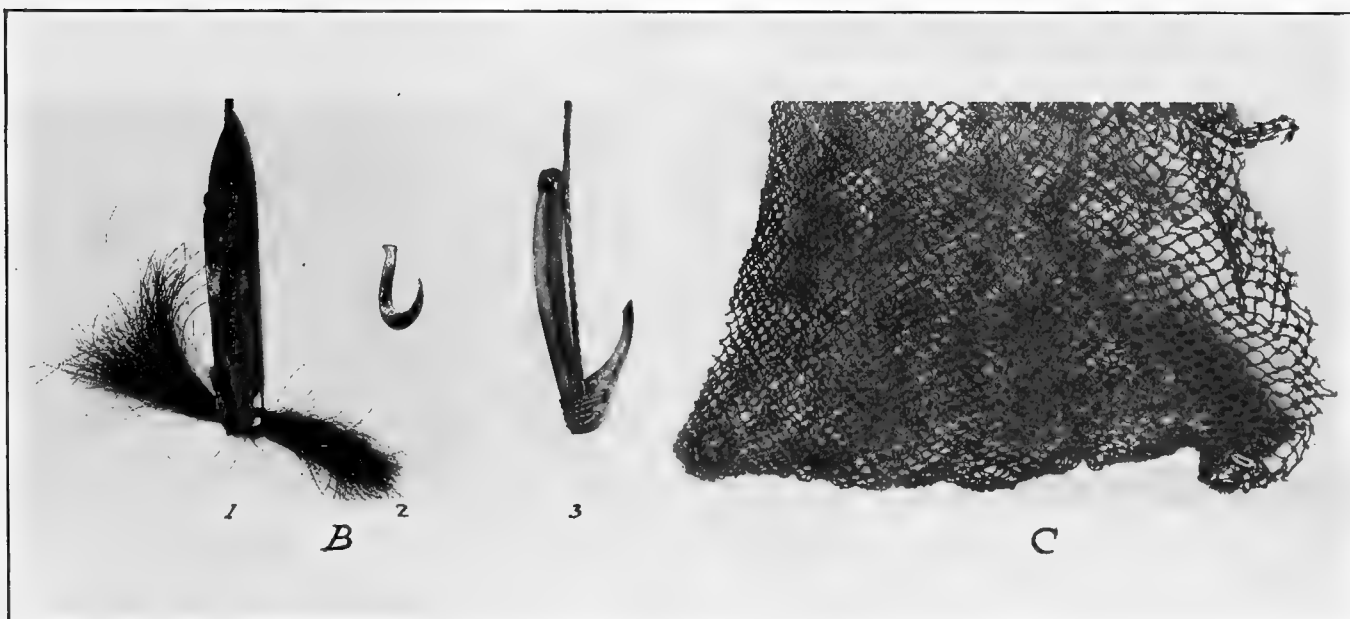
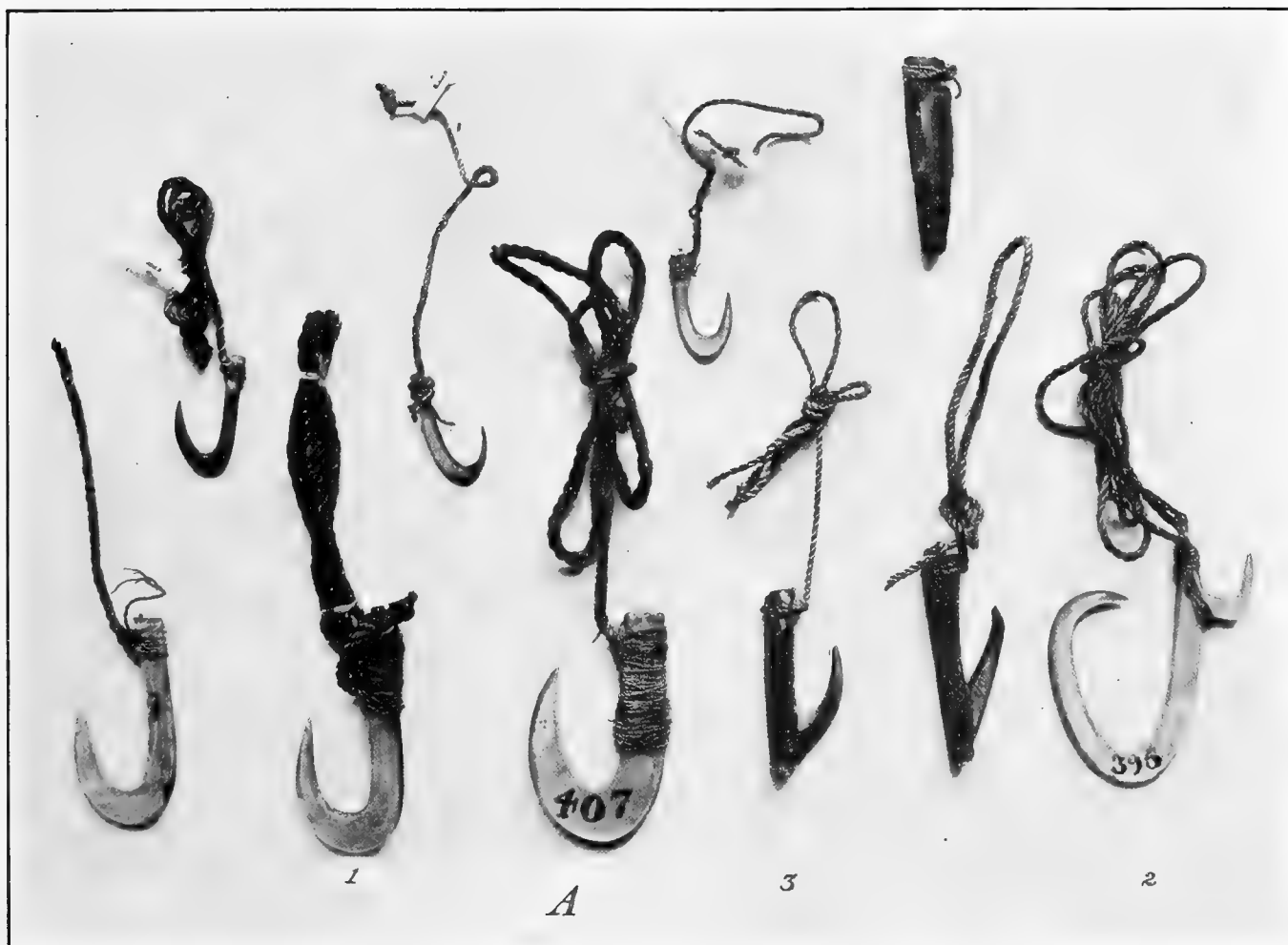
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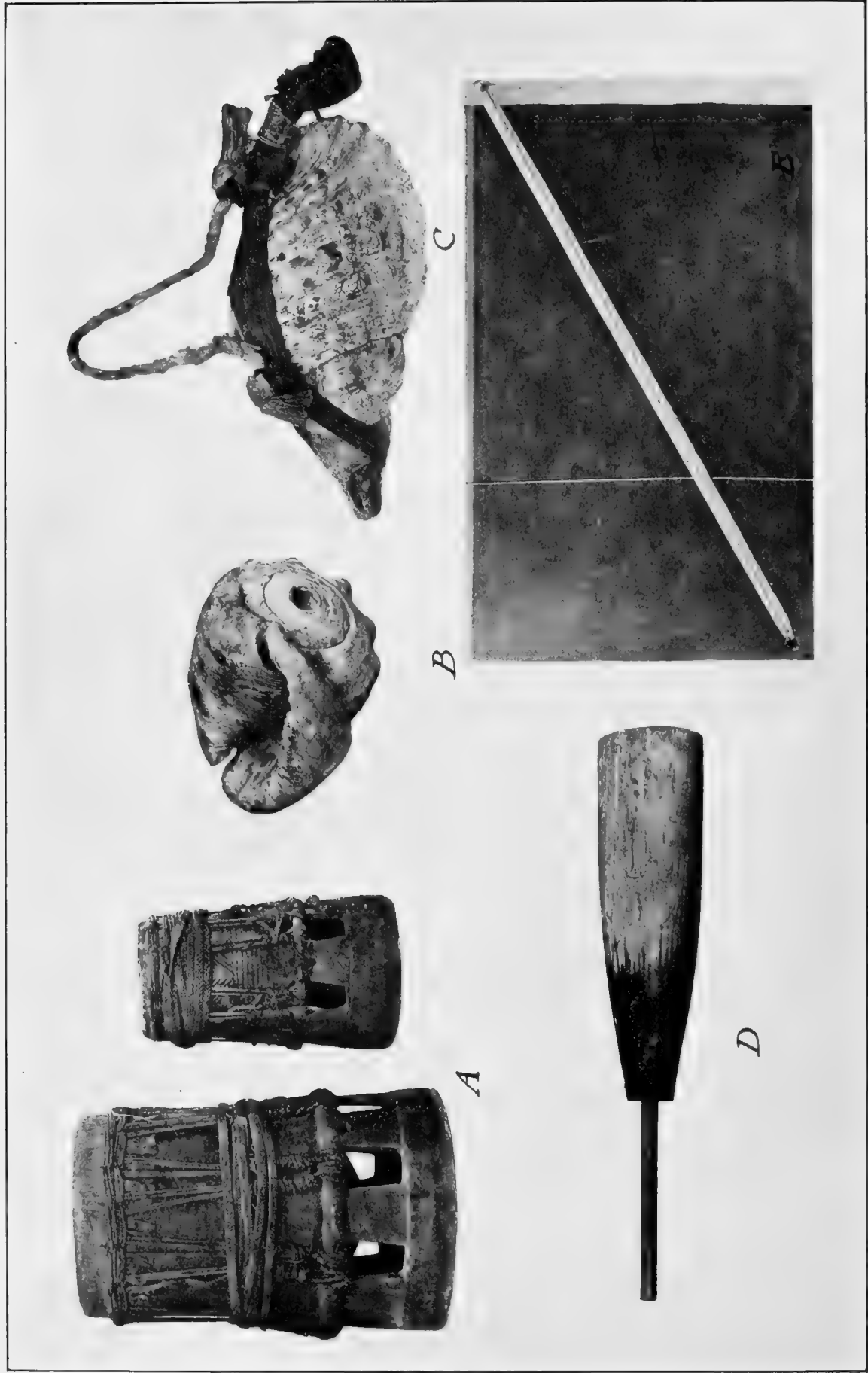
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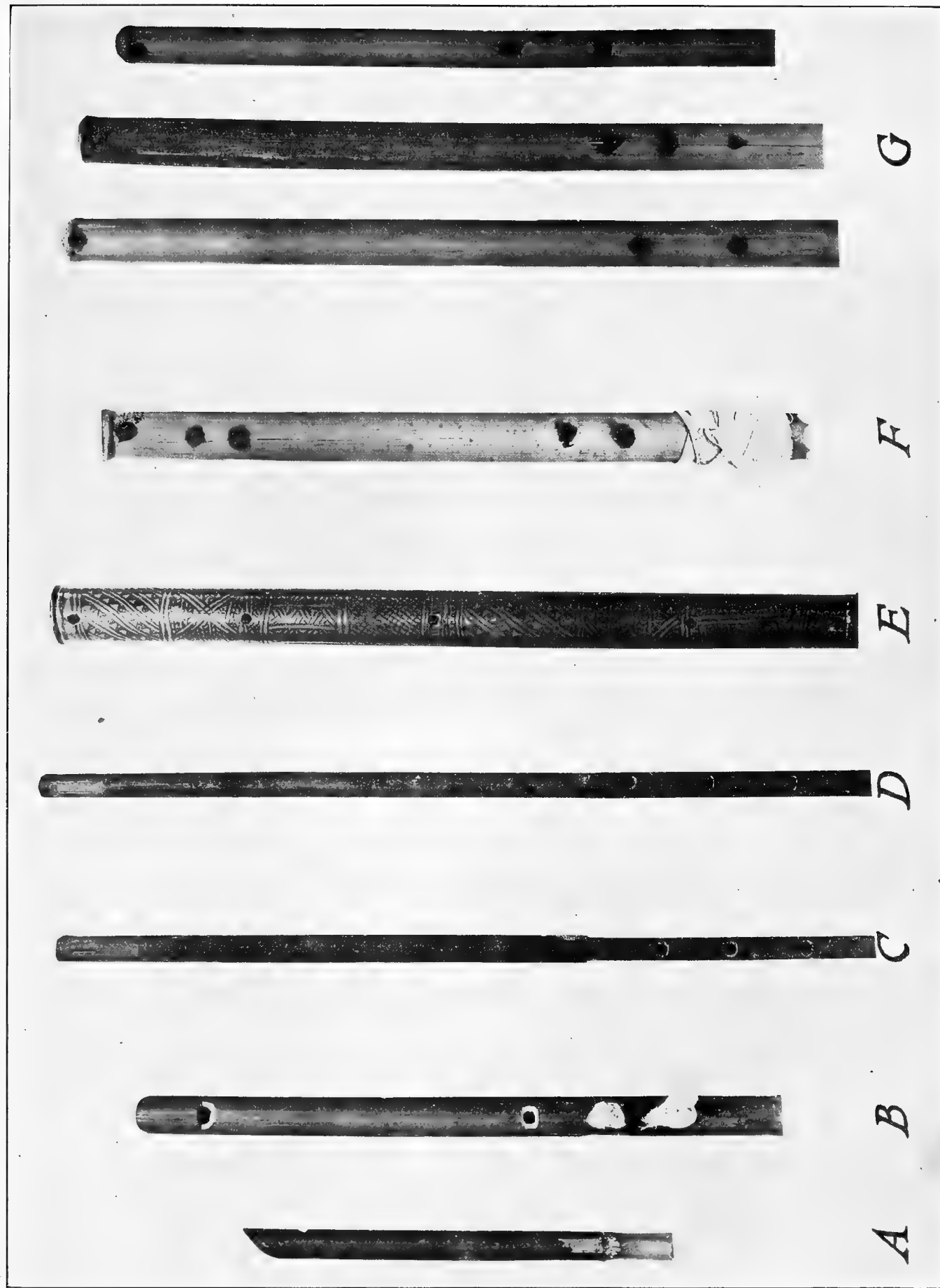
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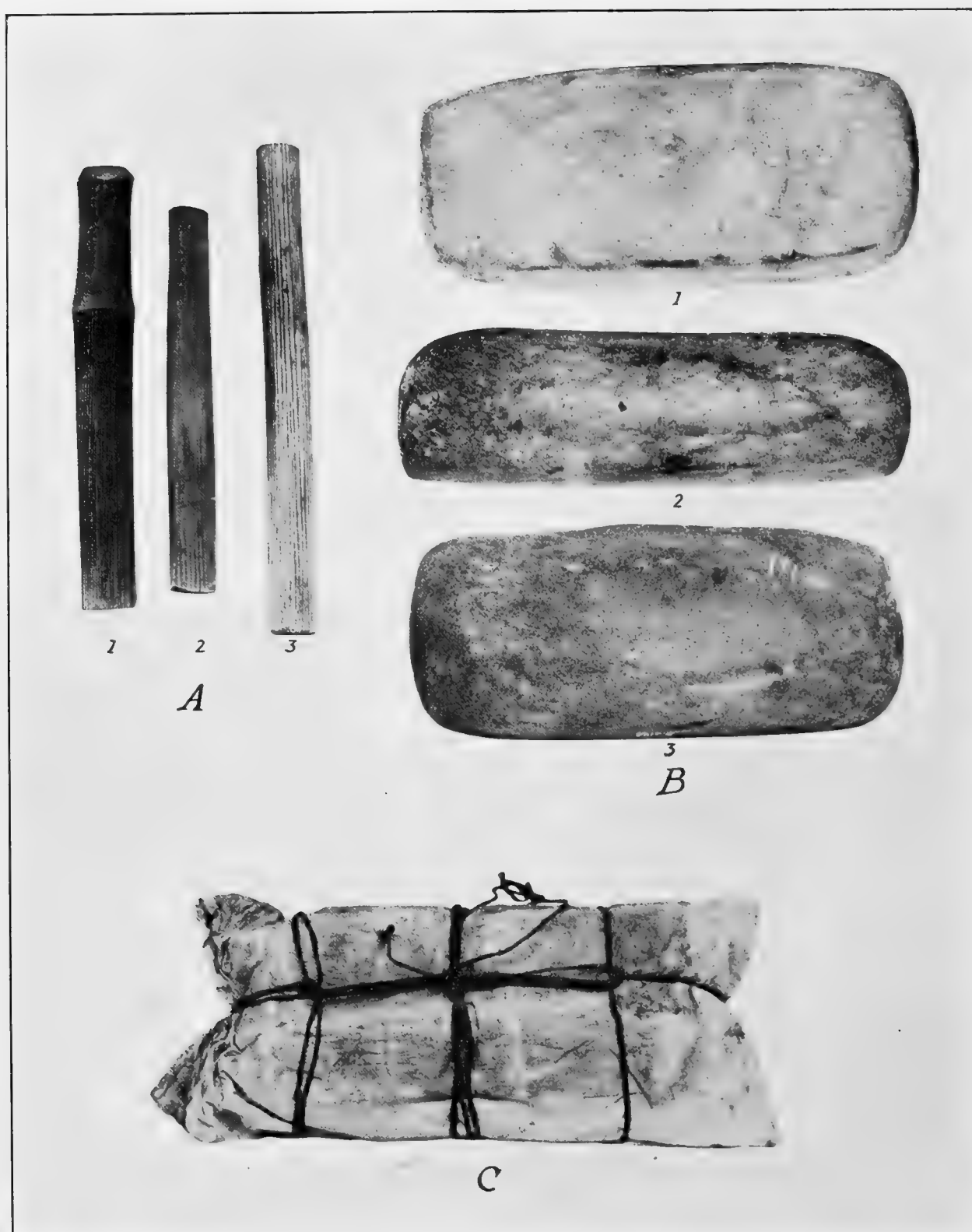
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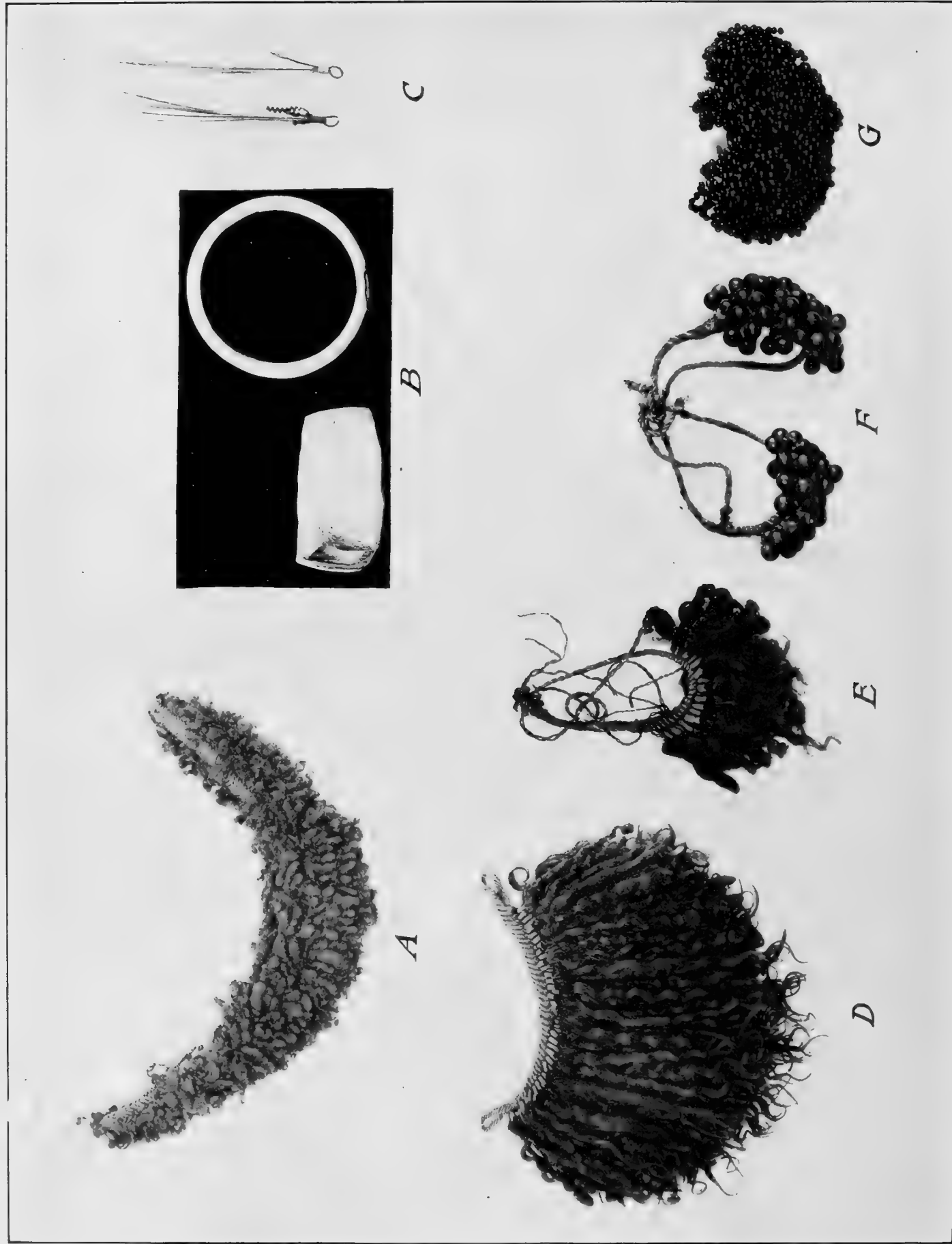
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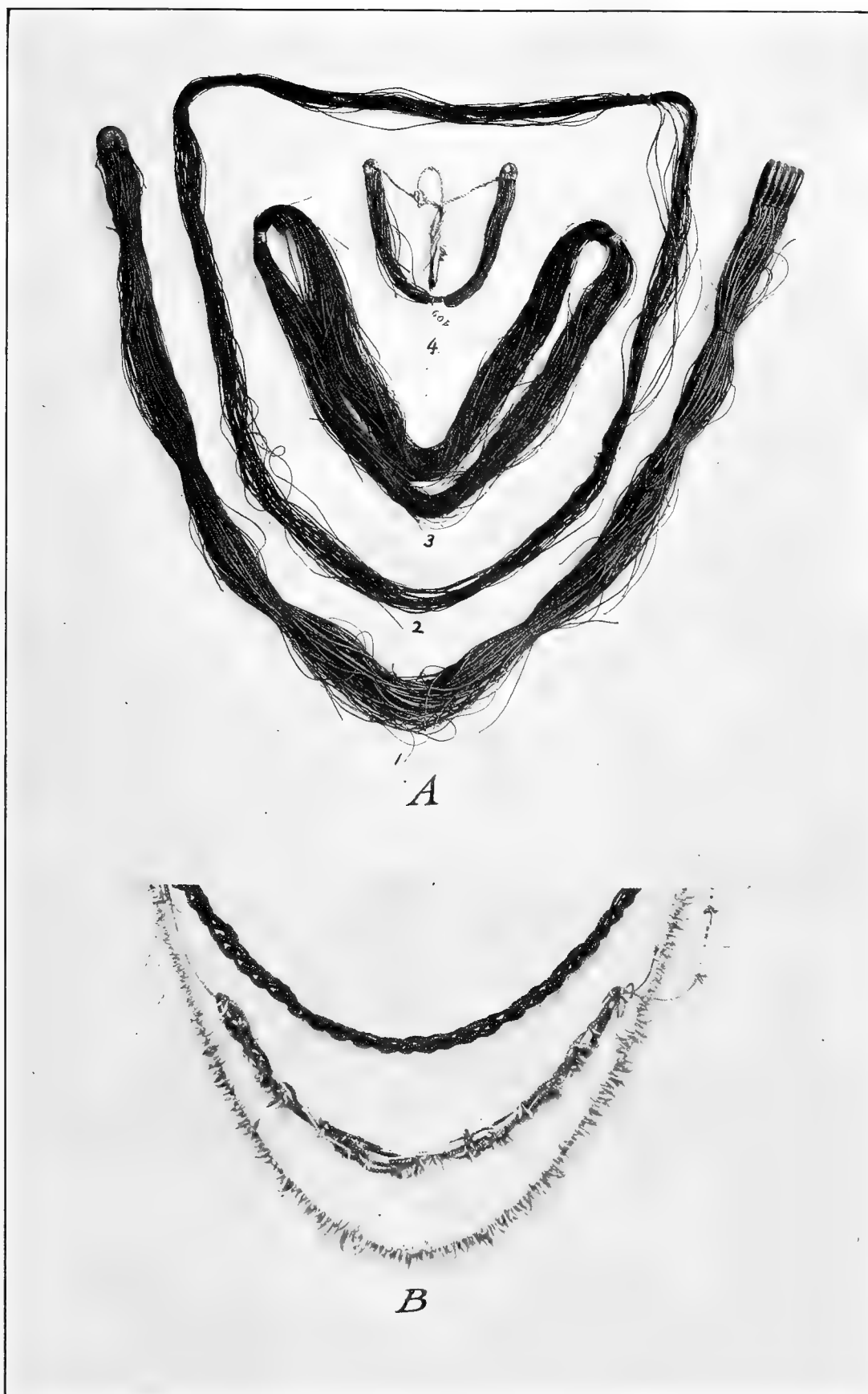
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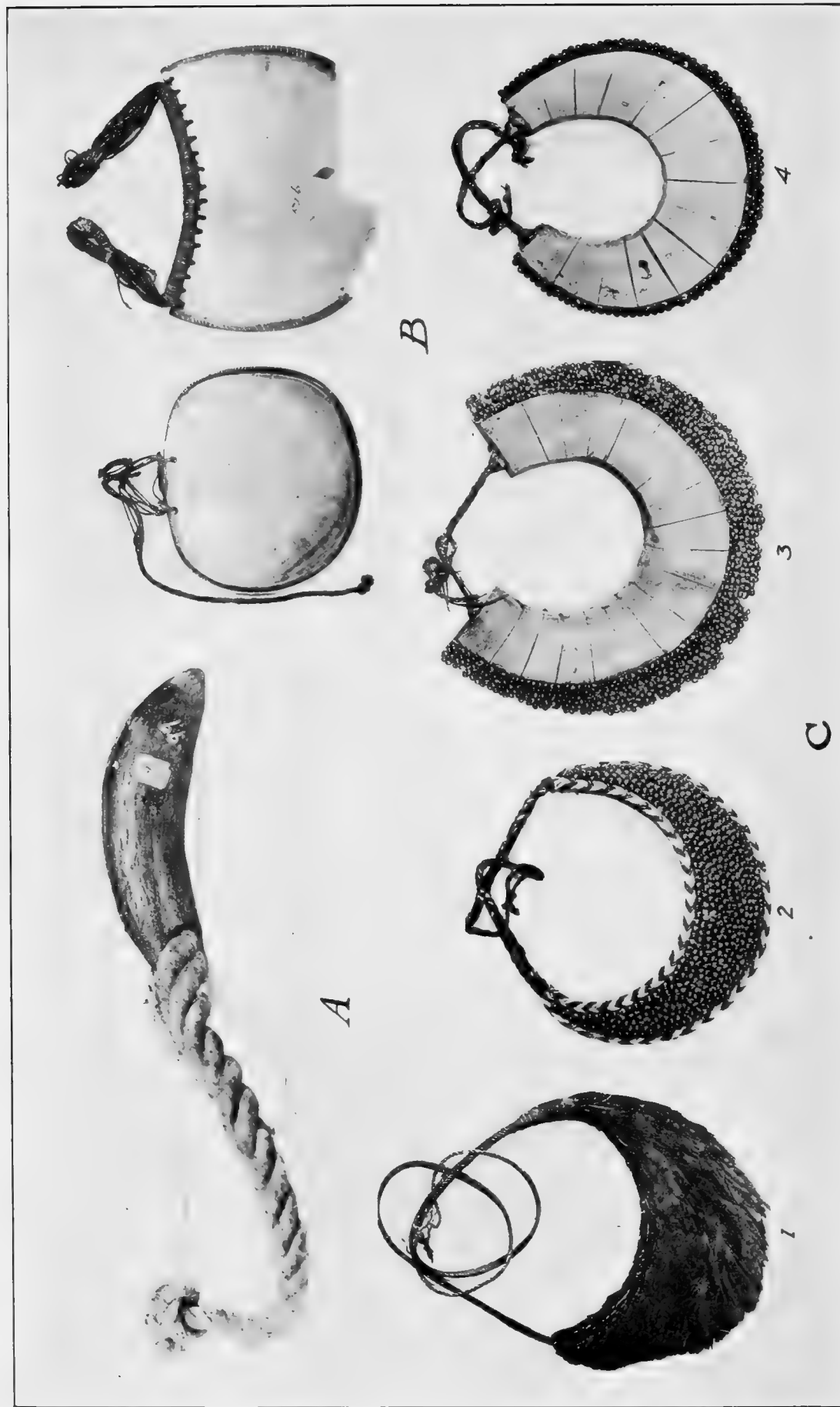
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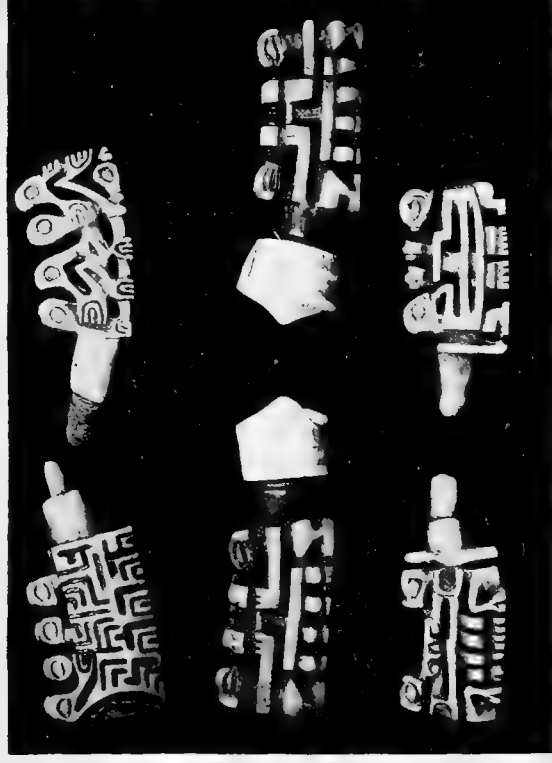
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A



B



C

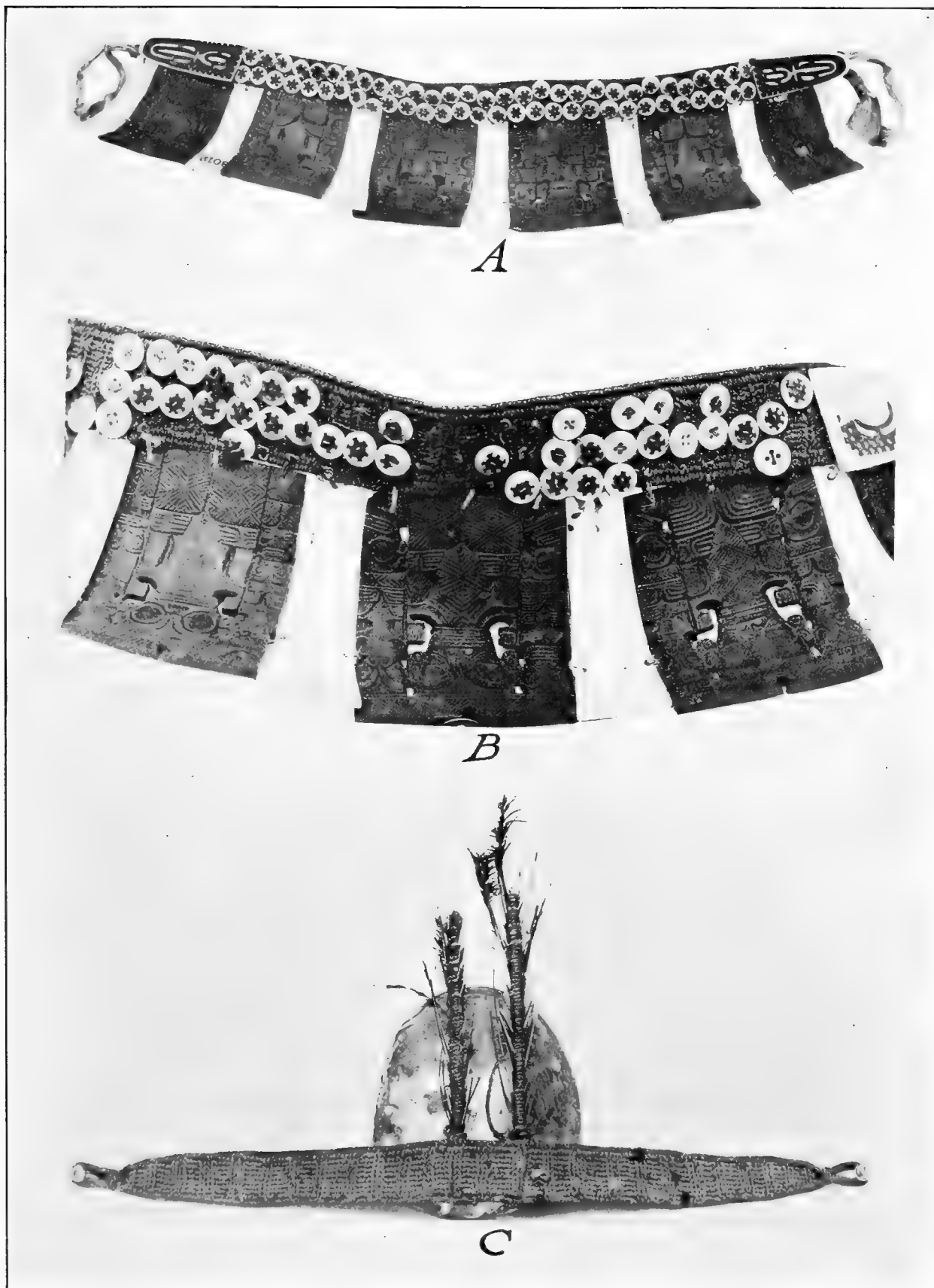


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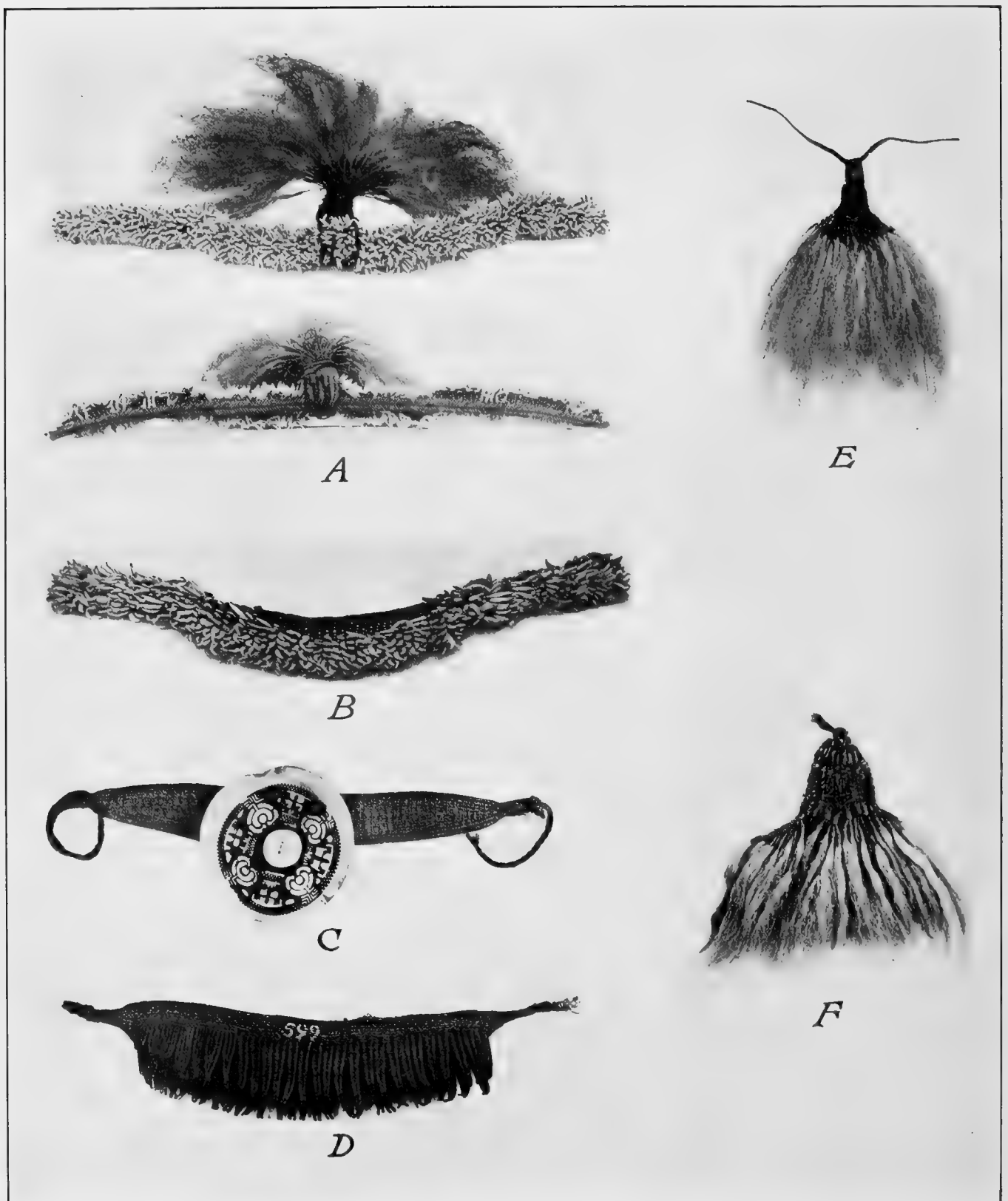
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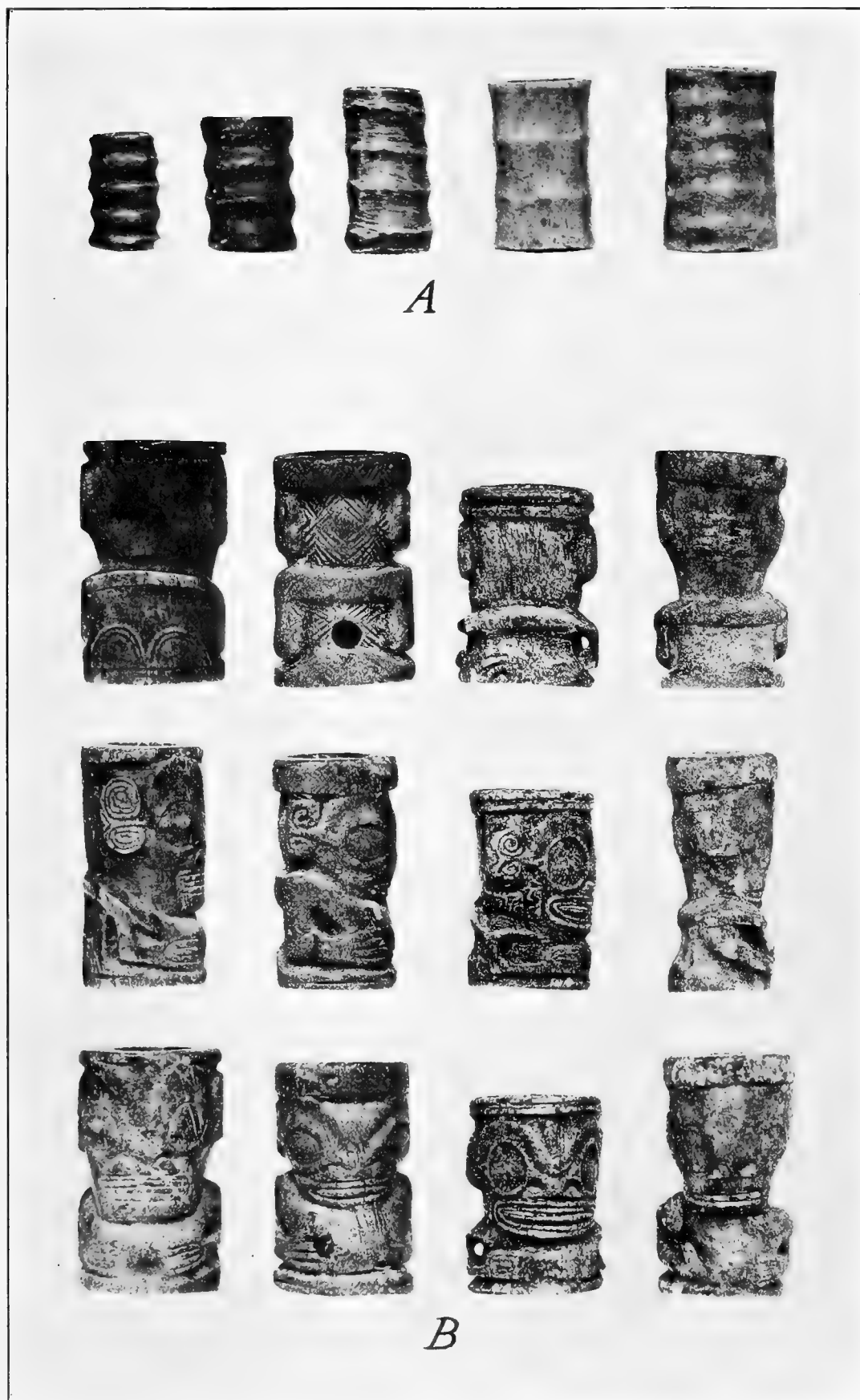
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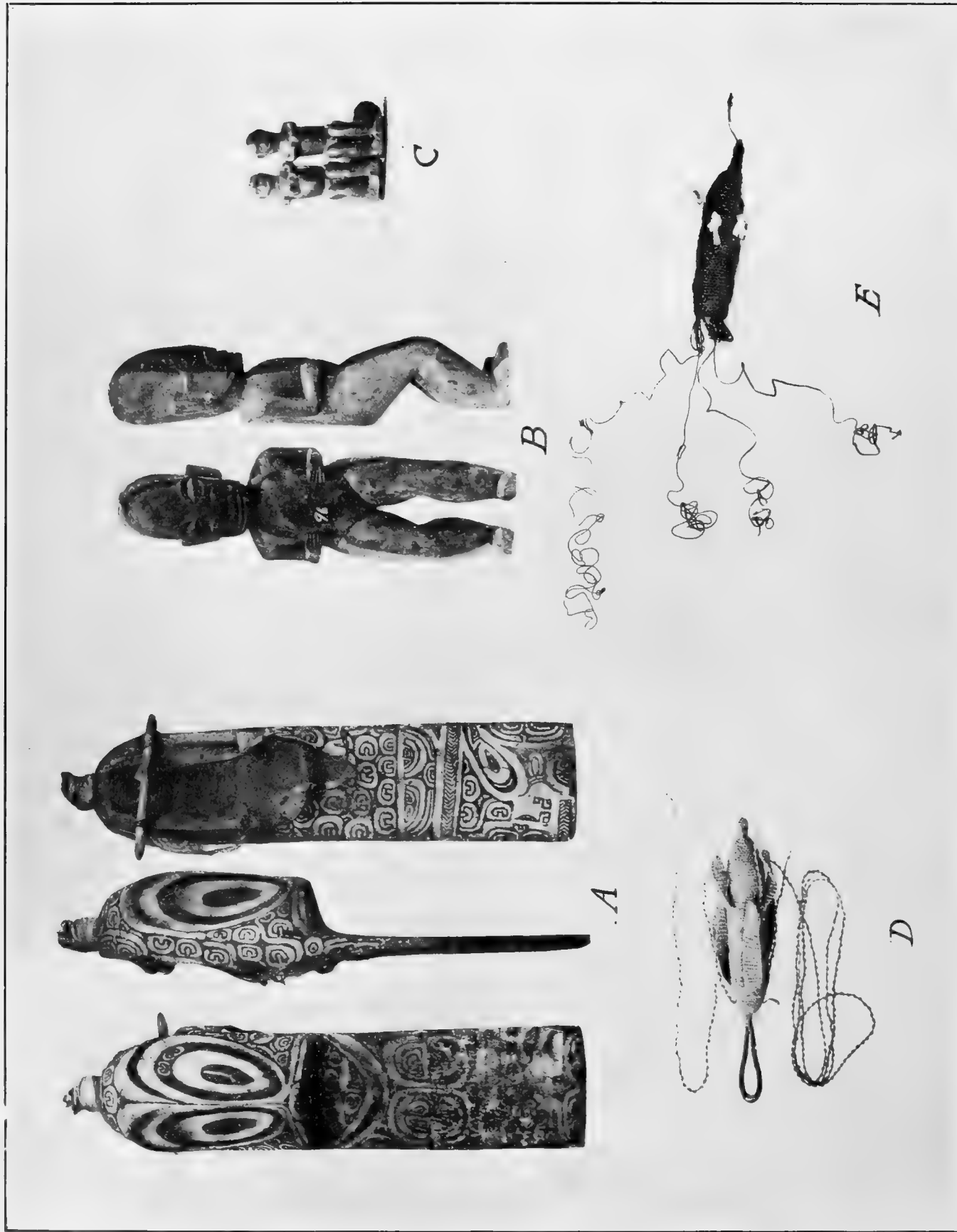
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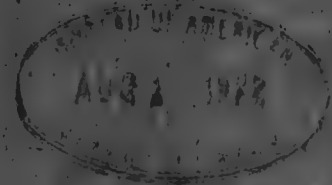
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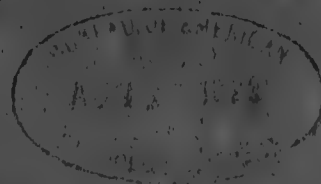
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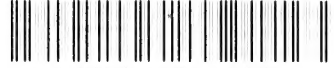
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